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Minerals Health and Safety In-House and Contract Research, Development, and Demonstration in Fiscal Year 1982

By Staff, Division of Minerals Health and Safety Technology

UNITED STATES DEPARTMENT OF THE INTERIOR

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By Staff, Division of Minerals Health and Safety Technology

UNITED STATES DEPARTMENT OF THE INTERIOR
James G. Watt, Secretary

BUREAU OF MINES
Robert C. Horton, Director

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MINERALS HEALTH AND SAFETY IN-HOUSE AND CONTRACT RESEARCH, DEVELOPMENT, AND DEMONSTRATION IN FISCAL YEAR 1982

by

Staff, Division of Minerals Health and Safety Technology

ABSTRACT

This publication summarizes, for potential contractors and all other interested parties, the research, development, and demonstration of in-house and contract projects programmed by the Bureau of Mines for fiscal year 1982 (October 1, 1981-September 30, 1982) under its Minerals Health and Safety Technology program. The objective of these projects is to provide an ordered and sequenced series of advance toward the Bureau's overall goal of providing the systems technology required to create a more healthful and safer working environment for the Nation's mining and minerals processing workers.

INTRODUCTION

The Bureau of Mines conducts a balanced, continuing in-house research and development program to accelerate systematic improvements in health and safety conditions in U.S. mines. Part I of this report outlines the Bureau's present in-house effort to all interested parties; in particular, potential contractors can refer to it when submitting USP's (unsolicited proposals), thus avoiding proposing research that duplicates work being performed by the Bureau.

It is the policy of the Bureau of Mines to utilize as fully as possible the capabilities of the private sector in minerals research, and to that end Part II of this report outlines the Bureau's current projected contract research needs.

The projects presented were planned at the beginning of the fiscal year and are subject to change based on emerging priorities and availability of funds. Contingencies may require that a significant portion of the program be deferred into fiscal year 1983 (FY 83) or beyond. It is important to realize that since this is a summary document, the project descriptions related to a design, fabrications, and demonstration effort do not necessarily imply total package procurement.

Contracts for the Minerals Health and Safety Research program will be conducted in strict accordance with Federal Procurement Regulations. Availability of requests for proposals (RFP's) will be formally advertised in the Commerce Business Daily. No additional information will be supplied on these projects until after the RFP's are made available and then only in strict accordance with prescribed procedures. This document is not intended to solicit proposals from the contracting community. All USP's whose content reflects the objective(s) of the proposed projects listed herein will be returned without formal review.

PROGRAM OUTLINE

The objective of the Minerals Health and Safety Technology program is to protect the health and safety of mining and minerals processing workers while insuring that newly developed technology incorporates health and safety criteria. In achieving this objective, four fundamental and complementary requirements must be considered by the research program, as follows:

1. Contributing to the viability of a basic industry.

2. Sustaining productivity.

3. Allowing for a return on capital investment.

4. Providing material and energy to the public.

Since mining and minerals processing involve a highly integrated and interrelated set of functions, the program has been divided into a set of interrelated subprograms, each with goals that will provide systems technology solutions to the problems within the framework of these fundamental requirements. The Minerals Health and Safety Technology program is divided into 12 subprogram areas as shown:

Health

- Respirable dust
- Radiation hazards
- Noise control
- Industrial hygiene
- Ventilation

Safety

- Fires and explosion prevention
- Methane control
- Ground control
- Industrial-type hazards
- Postdisaster
- Explosives
- Systems engineering

The objectives of these subprograms are described in the following pages, followed by the planned projects and their corresponding descriptions. The aggregate value of the planned in-house projects is approximately $21 million and of the anticipated contracts, $19 million.

PART I.--IN-HOUSE RESEARCH

Health

Respirable Dust

Program Objectives: To develop procedures for controlling the respirable dusts that still constitute the severest health problem facing the mining and mineral processing industries. To develop and/or improve techniques and equipment to prevent formation of hazardous dust concentrations, and to protect miners against dusty atmospheres.

Control of Dust Formation

1. Reduction of Airborne Coal Dust With Increased Machine Efficiency

Objective: To develop background information of a fundamental nature on coal cutting technology that supports long-term solution to problems of primary dust generation during coal cutting. To continue to determine the effect of cutting speed and the behavior of the dust cloud as it is ejected from the coal-cutter interface. To continue cooperative effort with Sandia Laboratories to develop a long-life, low-dust bit design based on the use of diamond compacts.

Control of Generated Dust

2. Dust Control by Chemicals and Chemical Additives

Objective: To continue to identify and develop the most cost-effective chemical dust controls for specific

applications in surface and underground mines. To develop guidelines for selection and use of chemical wetting agents through optimization of the sink and capillary rise tests.

3. Development of Improved Dust Control Technologies for Coal Mines

Objective: To continue to develop and evaluate improved dust control techniques in underground coal mines based on shrouded high-pressure sprays. Conduct surveys of longwall faces to relate dust concentrations and engineering parameters on those sections which are not in compliance with the 2 mg/m^3 standard. Transfer technology developed under contracts and in-house projects to the industry.

4. Dust Control Technologies for Metal and Nonmetal Mines and Processing Mills

Objective: To continue to conduct preliminary studies leading to development of improved dust control techniques for metal and nonmetal mines and mineral processing mills. To evaluate various preconditioning agents and their effect on lowering overall dust levels in processing plants. To demonstrate the feasibility and effectiveness of using a Bureau-developed, small, dry dust collector at a surface processing facility. To conduct field studies to define the effective dust protection factor of the Racal dust helmet.

5. Survey of Dust Control Problems

Objective: To determine the size distribution, concentration, and chemical composition of airborne particles in selected metal and nonmetal, diesel and nondiesel underground mines. Typical values and overall range of values shall be determined for the size distribution of quartz (free silica), diesel particulate, and selected trace elements and compounds.

6. Analysis of MSHA Health and Safety Inspection Data From Metal and Nonmetal Mines

Objective: Provide Mining Safety and Health Administration (MSHA) and Bureau personnel with trend analyses of airborne contaminant data and isolate locations and operations in specific mineral industries where respirable dust exposures are excessive. Additionally, historical summaries will be provided to MSHA and/or Bureau personnel interested in specific research areas (that is, noise, clay-shale, dusts, welding fumes), and labor statistics will be associated with each MSHA operation code.

Dust Instrumentation and Measurement

7. Respirable Dust Measurement and Instrumentation Evaluation

Objective: To initiate exploratory work on the design of coal mine respirable dust monitoring strategies for control of the miner's exposure. Continue to conduct short-term evaluation of newly developed instruments and measurement techniques. To seek out new aerosol detection techniques and determine feasibility of applying them to the measurement needs of the mining industry. To maintain an aerosol laboratory and continue to improve the in-house expertise in aerosol measurement.

8. Characterization of Airborne Coal Dust

Objective: To determine the size distribution of mineral particulates in coal dust samples with special emphasis on size of silica particles as related to type of mining operation and mineralogy of the inorganic constituents in the coal. To evaluate existing methods for silica determination in coal dust. Infrared, X-ray, and electron microscopic methods will be emphasized. Emphasis will be given to evaluating the effect of grain size on the magnitude of the

analytical signal and methods to reduce this grain size dependence. To determine the silica content of selected samples provided by MSHA and other agencies.

Radiation Hazards

Program Objectives: To develop and provide new and improved measurement instrumentation and control technology for protection of miners from exposure to radon and radon daughters and other nuclear radiation hazards in uranium and other mines.

Control of Radiation Hazards

1. Radon Control Technology

Objective: To continue modeling on the computer the effects of positive pressure ventilation and barometric pressure on the radon concentration using various permeability, diffusion, and porosity coefficients. Begin to develop computer programs to model ventilation effects and control of radiation hazards. To conduct preliminary studies under memorandum of agreement with two mining companies to determine the major sources of radon from intake to exhaust and the effects of fan shutdown (both surface and underground) on the radon-radon daughter concentrations in the mine. To continue laboratory and mine studies of transport of radon by water, dewatering of mill tailings slime for backfilling, and positive pressure ventilation.

2. Control of Radiation Hazards Through Air Cleaning

Objective: To continue research on the use of air-cleaning techniques for removal of radon daughters from underground mine atmospheres. Emphasis will be on performance of various prototype air-cleaning systems with regard to their efficiency in removing daughter products and their useful life expectancy in a uranium mine environment. To conduct a preliminary feasibility study of using high-velocity electrostatic air cleaners in mine ventilation tubing. To provide necessary technical assistance to the contractor during testing phase of a prototype air-cleaning system.

Radiation Instrumentation and Measurement

3. Electronic Radon Daughter Personal Dosimeter

Objective: To continue development and keep abreast of work in the area of radon daughter personal dosimetry. To engage in necessary technology transfer by providing technical assistance to potential users.

4. Personal Exposure Instrumentation and Measurement Technology

Objective: To conduct laboratory and field studies on instrumentation and methods for exposure measurement related to the miner's exposure to ionizing radiation hazards with emphasis on the measurement of radon daughter products. To evaluate the measurement of radon as a standard for exposure control and investigate radon dosimeters. To evaluate the effects of trace gases on the accuracy of radon measurements. To continue cooperative studies of passive radon detectors and active working level detectors. To continue the development of continuous detector systems for measuring working levels and radon.

5. Radiation Warning System for Uranium Mines

Objective: To continue field evaluation of full system at large uranium mining operations. To demonstrate standalone detector at smaller operations. To revise software and hardware to reflect improvements suggested by previous field tests. Modifications shall also be added to enable ventilation and other parameter monitoring.

Test Facilities

6. Lease and Operate the Twilight Mine

Objective: To operate and maintain an underground uranium mine as a test facility to provide typical mine environmental conditions for research and development studies conducted by the Bureau of Mines, MSHA, other Government agencies, and outside contractors in the area of radiation hazards. To continue to utilize the facility for the conduct of training sessions for MSHA, State, and industry personnel involved in measuring radon, radon daughter, and gamma ray exposures in mines. This training is done in cooperation with MSHA.

Noise Control

Program Objectives: To identify noise sources in underground and surface mines and in related mineral cleaning and preparation facilities, and to abate these noise sources sufficiently to meet Federal noise exposure standards.

1. Development of Noise Control Techniques for Coal Mining Machinery

Objective: To further the implementation of noise control techniques to the mining industry. This will be accomplished via equipment development and dissemination of information.

2. Noise Study of Lead and Other Metal-Nonmetal Mining in the Central United States

Objective: To identify work areas in metal and nonmetal mines where noise exposure of personnel is most severe and the need for noise control technology is most urgent.

3. Measurement of Noise Reduction Provided by Hearing Protectors Worn by Miners

Objective: To investigate methods of evaluating hearing protector performance that could be used to determine the degree of noise reduction provided in the field. The in-mine performance of personal hearing protectors is to be established, along with procedures and equipment to make in-mine measurement of hearing protector performance.

Industrial Hygiene (Toxic Substances)

Program Objectives: To identify and control health hazards in surface and underground mines and mineral processing plants caused by toxic gases and fumes, and certain particulates produced by explosives, combustible materials, and diesel engines. To develop and evaluate new instrumentation for monitoring these substances. To develop and/or refine analytical techniques for measuring and characterizing toxic substances, and investigate methods for controlling the formation and accumulation of toxic products. To analyze alternative power sources that may have health advantages over existing mine diesels.

Toxic Gases and Materials

1. Explosive Fume Characterization

Objective: To establish the relationship between toxic fumes produced in a 38,000-liter chamber and those produced in the Bichel Gage and C-J Apparatus and relate these to actual explosive fumes from in-mine measurements. To carry out fume measurements on all types of mining explosives including blasting agents and establish standard test procedures for the measurement of toxic fumes.

2. Improved Instruments for Mine Gases

Objective: To evaluate and verify the performance of commercially available or contract-developed instruments and devices for noxious and toxic gases. To acquire instruments and devices and evaluate their operation under varying conditions of temperature, humidity, and pressure. To determine the stability, accuracy, precision, sensitivity, and applicability to measure noxious and toxic gases in the mining environment. To assess air quality monitoring

strategies and methods to determine their effectiveness in the underground mine environment. To develop a portable, self-contained diesel exhaust gas analyzer which is mine rugged.

3. Measurement and Control of Welding Fumes

Objective: To assess related industry practices pertaining to measurement and control of welding and cutting fumes, dust, and radiation, and adapt this technology to confined work areas found in the mining environment. To determine the quantity and character of welding pollutants and personnel exposure levels. To propose control systems and/or isolation techniques to reduce or eliminate exposure to toxic substances resulting from welding and cutting.

4. Thermal Stress--Measurement and Protection

Objective: To develop a realistic, practical means to assess the high-temperature, high-humidity environments of the hot, deep, underground mines. To determine heat stress conditions in the mines which are detrimental to worker health. To evaluate the Imminent Danger Heat Stress Index programmed in a Hewlett-Packard 41C hand calculator in a human laboratory and in the mining environment.

5. Mercury Vapor Suppression in Mercury Ore Processing

Objective: To determine the conditions under which mercury vapor is released during grinding and froth flotation operations, and correlate these conditions with measured levels of vapor emmissions. To develop a hydrometallurgical alternative to the present roasting process for processing mercury concentrates into the pure metal.

Diesel Engines and Alternative Power Sources

6. Control of Diesel Exhaust Contaminants

Objective: To supplement contract research in the control and analysis of diesel exhaust emissions. To measure ambient contaminants and correlate with emissions data. To investigate control systems for contaminants by means of laboratory experiments. To devise and select analytical procedures for emission control systems and components at the tailpipe and ambient levels.

7. Investigation of Emission Controls for Diesel Engines Operated Underground and Alternative Power Source Assessment

Objective: To identify potential methods and hardware applicable for use as emission controls for turbocharged mine diesels. To review the literature as to the current state of knowledge pertaining to the use of internal combustion engines operating underground. To study applications of diesel equipment in new mining systems such as oil shale. To assess alternative power sources that may have health and operational advantages over existing mine diesels.

Ventilation

Program Objectives: To develop ventilation systems required to maintain a safe and healthful atmosphere conducive to efficient work output in noncoal mines.

1. Development of Improved Ventilation Technology for Noncoal Mines and Mills

Objective: To develop improved technologies for ventilating and cooling stopes and development headings in hot

metal and nonmetal mines. To develop improved and safe methods of heating shafts in winter to prevent ice buildups and to make the transport of personnel comfortable. To continue to develop methods of ventilating dead-ended working headings in metal and nonmetal mines.

Safety

Fire and Explosion Prevention

Program Objectives: To reduce the potential for fire or explosion in mineral extraction and processing operations; to minimize the danger to people on account of fires or explosions that do occur.

Prevention Research

1. Flammability of Mine Combustibles--Worn Belts, Containers, Brattice Cloth, and Electrical Spray Cleaners

Objective: (1) Evaluate flammability hazard of worn conveyor belts, aerosol sprays, and oil-grease containers. (2) Determine adequacy of current tests fo foam materials. (3) Develop small-scale flame test for brattice cloth.

2. Control of Float Dust

Objective: (1) Perform field demonstrations of engineering techniques such as water sprays and dust collectors to control float coal dust; (2) simultaneously, perform field tests of a new remote dust deposition monitor and new in-mine incombustible meter.

3. Float Dust Formation and Deposition

Objective: Redesign trickle duster to give size distribution of rock dust which more closely matches that of float coal dust.

4. Improved Bit Materials for Continuous Coal Mining Machines

Objective: To reduce frictional ignitions by improving the materials or the configuration of materials used in coal-cutter bits on continuous-mining machines.

5. Fire and Explosion Properties of Oil Shale

Objective: Continue to test fire and explosion hazard scenarios in large-scale tests involving bulk and dust samples; monitor methane emissions in operating oil shale mines; and conduct laboratory evaluations of spontaneous combustion of oil shale and explosibility of retort gas.

6. Fire and Explosion Hazards of Oil Mining

Objective: In collaboration with industry, develop and test fire and explosion scenarios in oil mines, test total combustible meters, and propose hazard prevention guidelines.

Ignition Research

7. Laboratory Dust Flammability Testing

Objective: To develop a reliable standard apparatus and procedure for evaluating flammability limits and pressure development for pure dusts in air and for dust-fuel gas mixtures in air. To correlate the data with full-scale mine studies. To investigate new, practical inhibitors as supplements to rock dusting. To investigate the adequacy of current rock dusting requirements in gassy mines.

8. Spontaneous Combustion of Mine Combustibles and Modeling for Coal, Oil Shale, and Sulfide Ore

Objective: To investigate spontaneous heating of mine combustibles including coal, oil shale, and purites and to develop reliable combustion criteria for identifying incipient mine fire hazards. To develop a mathematical model of spontaneous combustion in piles of coal, oil shale, and pyrites.

9. Ignition Hazard of Sintered Metal Brake Linings

Objective: To determine extent of the methane ignition hazard when using sintered metallic friction components in the braking systems of underground coal mining equipment. If a hazard exists, develop an evaluation method including suggested guidelines.

10. Thermal Ignition of Coal Dust

Objective: Determine the mechanism of ignition of dust clouds and layers and delineate the effectiveness of methods of preventing ignition.

11. Bit Parameters for Methane Ignition Reduction

Objective: Perform fundamental studies to improve bit design and define best bit usage to reduce the probability of methane ignitions caused by frictional impact heating during cutting.

12. Pacification of Sulfide Oxidation

Objective: Determine the kinetics and mechanisms of low-temperature oxidation of sulfides, particularly pyrite, to identify the rate controlling step(s). Apply the results of this study to identify chemical and physical inhibitors and validate in mines the ability of these inhibitors to prevent or retard sulfide oxidation and reduce the probability of mine fires and the resultant loss of property and life.

13. Retorting Process Ignition Hazards

Objective: Make an assessment of potential hazards associated with in situ retorting process. Identify possible retort gas compositions, and hazardous scenarios. Identify those areas that should fall under hazardous area classification. Identify the most dangerous parameter configurations and the technical information necessary to ensure safe operation. Generate the necessary data. Make recommendations to MSHA regarding future safety regulations.

Suppression Research

14. Explosion and Fire Ignition Prevention and Suppression

Objective: Develop, test, and conduct field trials of new tool bit materials and/or tool bit geometries for the prevention of face ignitions; barriers for the suppression of face ignitions; barriers for the suppression of gas and coal dust explosions.

15. Fire-Suppression System Component Ruggedization and Fire-Resistant Water-Glycol Fluid

Objective: Develop improved ruggedized fire-protection hardware and procedures for mobile mining equipment. Also, monitor development by Government and industry of water-glycol fire-resistant hydraulic fluids.

16. Improved Mine Fire Protection

Objective: Improve fire safety in underground metal and nonmetal mines through tests of improved early fire warning systems in the FMC Corp. Green River Mine, AMAX Henderson Mine, and Noranda Lakeshore Mine.

Propagation Research

17. Full-Scale Mine Explosion Research and Bulkhead Tests

Objective: To conduct research on the propagation and suppression of full-scale explosions of dust and gas in experimental mines; to develop and maintain instrumentation in both the experimental mine and in Lake Lynn Laboratory; to evaluate the strength and endurance of explosion-proof bulkheads and water seals using full size candidate bulkhead with appropriate anchorage.

Extinguishment Research

18. Sealed Mine Fires

Objective: Develop needed guidelines for safe reopening of a mine

following the sealing of a coal mine fire and evaluate reliability of fire-detection systems.

Detection, Instrumentation, and Alarm

19. Evaluate Detection Systems for Fires in Mine Passageways

Objective: (1) To develop adequate fire sensors and sensing methodologies; (2) to define detection criteria and associated guidelines for the optimum deployment of sensors and sensing systems for early warning of fires.

20. Microscopic Structure and Composition of Combustible Dusts and Residues

Objective: To determine pre- and post-explosion information on the surface characteristics, size distribution and compositional distribution of (1) combustible dusts, (2) mixtures of dusts and inhibitors, and (3) the effects of added methane on those surface characteristics, and to use such information for post-disaster investigations.

21. Remote Methane Detection

Objective: To determine the Raman scattering properties of methane and other flammable gases; to develop and demonstrate on the laboratory scale remote measurement techniques for methane.

22. Mine (Fire) Ventilation, Code, Modification, and Maintenance

Objective: The improvement of the applicability, utility, and acceptability of the mine (fire) ventilation simulation computer program developed by Michigan Technological University (under contract J0285002) for the Bureau.

Methane Control

Program Objectives: To develop, demonstrate, and transfer technology that will prevent the formation of flammable methane-air mixtures in underground mine workings through improved ventilation and procedures for degasifying the mineral deposit in advance of and during mining. To establish correlations between the geology of the mineral, adjacent strata, and their gas content, and to use these correlations to predict methane emission hazards.

Fundamental Factors

1. The Origin and Geologic Influences on the Migration of Methane Into Metal and Nonmetal Mines

Objective: To establish, by means of data obtained by in-mine and laboratory studies, the stratigraphy and geological structures that contribute to varying concentrations of gases within metal and nonmetal mines; to determine the composition of gases and the factors that influence the migration and retention of these gases into metal and nonmetal mines; and to develop predictive models for the occurrence of gassy areas within the ore bodies in advance of mining.

2. Influence of Geology on Occurrence and Emission of Methane in Coal Measures

Objective: To conduct geologic investigations of gassy, minable coalbeds to determine the factors controlling the amount and distribution of methane, and the effect on mining; determine the gas contents of U.S. coalbeds and improve predictive techniques; determine the influence of coal macerals on gas generation and retention; aid in assessing the geologic feasibility of proposed methane drainage sites.

3. Prediction of Coalbed Discontinuities to Increase Effectiveness of Drilling for Methane Drainage

Objective: To determine fundamental geological criteria that can be used to predict the presence of coalbed discontinuities in advance of mining and to refine statistical techniques that can be used to evaluate the probability of

encountering discontinuities during methane drainage drilling. Particular emphasis will be placed upon those discontinuity characteristics that adversely affect methane drainage projects.

Control in Advance of Mining

4. Application of Vertical Borehole Methane Drainage to Mine Safety

Objective: By demonstrating the feasibility of draining gas in advance of mining from gassy coalbeds through vertical boreholes, this project will determine the effects of borehole spacing and methods of stimulation on reducing methane gas emissions into mine workings.

5. Investigation of Available Technology for Directional Drilling of Coalbeds

Objective: To improve the technology of directional drilling for removing methane from coalbeds in advance of mining.

Control During Mining

6. Application of Horizontal Drilling Technology to Health and Safety Problems in Metal and Nonmetal Mines

Objective: To conduct detailed analysis of methods for locating and identifying gas-bearing in metal and nonmetal mines by drilling small-diameter holes in advance of mining, and to investigate techniques for reducing or eliminating the hazards associated with the rapid release of energy (outbursts) when mining encounters the gas-bearing zones.

7. Development of Control Techniques Using Horizontal Boreholes

Objective: To determine the effectiveness of long, horizontal boreholes on reducing methane levels during mining through natural drainage, and to determine the application of drilling in advance of mining to locate and identify areas, such as clay veins, fault zones, and other coalbed discontinuities, that may cause problems for future mining.

8. Gob Degasification From Underground Locations

Objective: To determine if methane emissions from gob areas of longwall panels can be effectively controlled by drilling small-diameter boreholes into the overlying strata from within the mine before longwall mining begins.

9. Ventilation in Control of Methane

Objective: To reduce mine air leakage by improving mine stopping construction methods and materials and to develop better methods of ventilating the working sections of coal mines.

10. Design and Development Improved Horizontal Drilling Equipment for Methane Drainage

Objective: To design and develop faster and longer reach horizontal drilling equipment for use in underground mine methane drainage projects.

Ground Control

Program Objectives: To conceive, develop, demonstrate, and transfer technology that will prevent mine accidents attributable to falls of ground, outbursts, slope failures, and collapse of waste impoundment structures.

Mine Design and Development

1. Delineation of Abandoned Mine Workings and Other Mining Hazards With Integrated Geophysics

Objective: Field test high-resolution seismics, acoustic seismics, radar, resistivity measurement, and controlled-source tellurics over known abandoned mine workings. The data from these tests will be processed with the latest integrated geophysics modeling, and reverifies with onsite drilling. Further development of three-dimensional radar and seismic techniques will also be covered.

2. Use of High Resolution Resistivity System To Locate Abandoned Mine Workings

Objective: Establish operational techniques for using high-resolution resistivity to detect old abandoned mines in proximity to current mine activities and to demonstrate the effectiveness of the method for hazard detection in a variety of mining areas.

3. Computerized Remote Sensing Techniques for Detection of Potential Hazards in Mine Areas

Objective: Refine and demonstrate to the mining industry the use and the advantages of a developed computerized remote sensing technique for the detection of geologic hazards, which may cause sudden inundation and roof falls. A secondary objective is to determine the optimum satellite image types and scales for hazard detection.

4. Develop Improved Coal Mine Design Procedures

Objective: Develop the practical application of analytical techniques to a coal mine design using the MIN SIM-type computer program and the confined core pillar design method, and demonstrate their use in designing safer coal mine openings, pillar, and extraction layouts.

5. Evaluation of Room-and-Pillar Design Methods

Objective: Evaluate existing published pillar design methods, select the more promising, modify and develop new methods, test selected methods in mines, and publish the most practical and useful methods in as-design guidelines for room-and-pillar mines.

6. Influence of Roof and Floor Rocks on the Strength of Coal Pillars

Objective: Demonstrate the need to account for the properties of the roof and floor rocks when estimating pillar strength that occurs when coal is tested between platens made of rock, rather than of steel. The potential impact of roof and floor rocks on the application of laboratory test data to coal mine design, and on future test methods, will be determined.

7. Entry Design for Longwall Mining on Steeply Pitching Coal Seams

Objective: Demonstrate the application of computer modeling techniques to planning of a longwall coal mine operation in a steeply pitching seam, with emphasis on establishing an optimum safe entry width as a function of overburden depth.

8. Analysis of Cutter Roof in Coal Mines Using the Finite Element Method

Objective: Demonstrate the practical applicability of the finite-element structural analysis method in establishing the cause and predicting the formation of a cutter-roof failure, and determine design alternatives that reduce the occurrence of cutter-type roof falls in coal mines.

9. Face Slabbing Along High Longwall Faces in the Western United States

Objective: Investigate the face slabbing problem along high longwall faces in the Western United States and devise remedial measures for trial for controlling face slabbing to improve safety, increase production, and increase coal recovery.

10. Assessment of Clay Vein and Slikenside Support Techniques

Objective: Determine the various support procedures and mechanisms used on clay veins of various types and assess the support techniques in terms of their effectiveness and appropriateness for particular structural details of clay veins.

11. Development of Classification of Mine Roof According to Support Mechanism Efficiency

Objective: Develop a systematic framework for classifying mine roofs based on observed effective control techniques. Data already collected from 22 mines will be analyzed to aid operators in selecting the best available roof system for their mines.

12. Anchorage of Inundation Bulkheads in Coal Mine Openings

Objective: Test and evaluate the various methods of anchoring inundation bulkheads in underground coal mine openings and develop a handbook of inundation bulkhead design and construction. The testing will encompass the range of factors that affect anchorage, such as deterioration with time, water pressure, environmental constraints, and the material composition of roof, floor, and ribs.

13. Development of Design Procedure to be Used in Layout of Workings In Multiple-Seam Mining Situations

Objective: Development of a technique to assess the impacts (from the point of view of vertical pressure peaks) of a mine layout in the vicinity of a previously mined seam. This will be accomplished by inputing the description of the old workings, and proposed layout for the new workings. The resulting vertical pressure contours in the new workings will be calculated and output in an iterative mode until the designer is satisfied with the resulting pressure contour data.

14. Prediction of Unstable Mine Roof Based on Remote Sensing Analysis

Objective: Verify the relationship between photo linears and unstable roofs and identify the geologic features associated with the photo linears on two mines for which aerial photographic and/or satellite imagery analysis has been done.

15. Full-Scale Model Testing of Roof Bolting Systems

Objective: Perform full-scale model tests of roof bolting systems using the SRC Model Roof Bolt Test System. Also, replace the model mine opening with a new set of concrete slabs for the next series of tests.

16. Analytical Modeling and Field Verification of Roof Bolting Criteria

Objective: Develop guidelines for roof reinforcement using mechanically anchored bolts, fully grouted bolts, friction stabilizers, inorganic grouted bolts, inclined bolts, and roof truss systems. Characterize the field conditions best suited for each method. Validate the most tenable rock bolt support theories developed by previously completed contract research.

17. Safety Procedures for Reducing Roof Falls Due to Swelling and Slaking Roof Rock

Objective: Measuring surface properties, bulk properties, and the shear strength of coal measure rocks during wet-dry cycles, establish "damage factor" and "durability index," and develop procedures to mitigate roof falls that may result from swelling, slaking, and weakening effects of coal measure rocks due to humidity changes.

18. Engineering Properties of Coal Measure Rocks in the Illinois Coal Basin

Objective: Develop engineering property data for ground control application and geophysical detection of geologic hazards in the Illinois Coal Basin. Core and rock samples from various localities in that region will be tested to determine mechanical properties including uniaxial and tensile strengths, triaxial shear strength, acoustic wave velocities, and dynamic elastic moduli.

19. Longwall Mining Design Parameters

Objective: Determine the critical design parameters for safe longwall mining systems by measuring the mining-induced load transfer, measuring the roof and floor strata movements, and determining the roof and floor strata-bearing capacities.

20. Demonstration of a Single-Entry System for Longwall Mining

Objective: Develop and demonstrate a single-entry development system designed to reduce ground control hazards associated with retreat longwall mining. This project will provide a method for economic and safe extraction of deep coal resources.

21. Ground Control Design for Hard Rock Mines

Objective: Develop analytical design procedures and criteria that will reduce the structural instability associated with underground hardrock mining systems. The focus will be on the interacting influence of the floor, roof, and suppor structures and its impact on overall mine stability. Primary emphasis will be on entry development and selection of mining systems in evaporite deposits.

22. Evaluation of Ground Stability Problems in Quarry Operations

Objective: Identify ground control hazards in selected quarries and determine the relation between quarrying-induced stresses, rock structures, and ground stability.

23. Pillar Destressing in Advance of Mining

Objective: Demonstrate how to destress rock-burst-prone stope areas in advance of production mining. Instrumentation installation in the test block on the 7900 level of the Star Mine, Idaho, will be monitored to assess a full-scale application of the destressing techniques.

24. Pre-Mine Planning To Reduce Ground Control Problems and Rock Burst Hazards

Objective: Improve ground control and minimize rock burst hazards in deep metal mines by utilizing advanced structural analysis to design stope geometry and plan mining sequences.

25. Mechanical Properties Handbook and Data Base

Objective: Prepare a manual and mechanical property numerical data base for a wide range of rock types encountered in metal and nonmetal mines. Data sets will include rock density, permeability, porosity, wave velocities, dynamic elastic constants, uniaxial compressive and tensile strength, indirect tensile strength by Brazilian line-load method, shore hardness, and other properties.

Hazard Detection and Monitoring Systems

26. Automatic Roof Fall Warning System

Objective: The immediate objective is to test the commercial prototype, microseismic roof fall warning system, modify it as necessary to achieve a high reliability, and transfer the technology to industry. The overall objective is to provide a reliable automatic device to warn of impending roof falls to assure that people are not in the area during failure.

27. Coal Mine Bounce and Outburst Studies

Objective: Show the applicability of microseismic techniques in locating bounce and/or outburst failure areas relative to mine structures and predicting each failure. Work to date has shown these techniques effective, but

additional research is needed to determine their reliability and define the ways and means in which industry may use them.

28. Validity of Existing Blasting Proximity Criteria and Scaling Laws

Objective: Determine what constitutes damage to an underground mine opening and quantify the relationship between the magnitude of the measured parameter and the damage produced. Evaluate the parameters such as particle velocity, displacement, and strain, and determine which parameter will best indicate probable damage. Guidelines will be developed for estimating safe operating distances between surface blasting operations and underground coal mine openings.

29. Mine Roof Movement Warning System

Objective: Develop a simplified and cost-effective method using a laser beam to monitor the stability of the roof in main entries, passageways, belt lines, and escapeways. Demonstrate the technique as a reliable, easily installed and maintained system. Make the system easily movable to new locations.

30. Application of In-Seam Seismic Techniques for Detection of Voids and Faults

Objective: Establish the uses and limitations of seismic seam wave technology for the detection of voids and faults ahead of the working face in U.S. coal mines. Optimum field and interpretive procedures will be established for generating and detecting the desired mode of signal propagation. The resolution of the method under various conditions of coal seam geometry and with representative target anomalies will be analyzed, and recommendations will be made for future implementation of the guided wave method as a tool for hazard detection from underground working faces.

31. Develop and Demonstrate Untrasonic Closure Rate and Roof Fall Prediction Device

Objective: Develop and field test an intrinsically safe, ultrasonic, roof-floor closure measuring device which is to be nonobstructing for use in haulageways and other high traffic areas for early prediction of roof falls.

32. Detection of Bad Roof by Resonance

Objective: Develop a device for sensing bad roof and impending roof falls during mining based on the dynamic characteristics of coal measure rocks in the presence of geologic anomalies. This work will determine the dynamic characteristics and response of roof rocks to external excitation by small amplitude impulse and periodic excitation. The results will be used as indices of rock stability and applied to the design and construction of a device to predict the structural integrity of the mine roof and impending roof falls.

33. Coal Mine Hazard Detection by Acoustic Methods

Objective: Develop and test an acoustic monitoring system for detecting hazardous roof conditions in coal mines. The system will be based on available instrentation at the Bureau's Twin Cities Research Center.

34. Detection of Coal Mine Roof Fall Hazards Utilizing Electromagnetic Sensors

Objective: Evaluate the state-of-the-art of low-frequency electromagnetics and ground penetrating radar systems and develop suitable techniques to detect potential roof falls and other hazardous conditions in underground coal mines, from within the mine.

35. Field Test of Slope Stability Monitoring System

Objective: Evaluate, through field tests, the capability of the microseismic slope stability monitoring system that has been developed by the Bureau to detect and to give advance warning of a pit wall failure.

36. Application of Rock Burst Technology and Failure Control Methods

Objective: Consolidate the state-of-the-art of rock burst detection systems, their methods of use, data analysis and prediction techniques, and rock burst control methods into a format to be transferred to industry. This format will also allow for an up-to-date assessment of the need for future research. New data gathered during this fiscal year will also be incorporated into the final format, with special emphasis on the current practice of destressing for rock burst control and its effects on mine structure as a whole.

37. Prediction and Control of Rock Bursts and Failures in Mines

Objective: This project has three objectives: (1) to develop effective and reliable methods of predicting rock burst and controlling burst prone stopes; (2) to apply these methods to a mine with burst-prone stopes; and (3) to establish criteria and procedures basic to the problem of determining mine structure stability and how structural instabilities contribute to mine failures. Data obtained from the digital microseismic system at the Galena Mine, Idaho, will be compared with the analog system currently employed at the mine, and an effort will be made to identify anomalous zones prior to bursts and to characterize microseismic activities from stressed and destressed zones.

38. Develop Fiber Optic Transmission System for Seismic Events

Objective: Improve the transmission of seismic data in electrically noisy mediums by eliminating all electrical connections between the transducer (seismometer) and the recording instrument and replacing it with fiber optic transmission.

39. Improved Rock Burst Monitoring

Objective: Improve rock burst monitoring capabilities as a supportive research tool for delineating areas of high stress buildup and selecting mining methods and procedures that will minimize bursting. An improved monitoring system for rock burst studies in the Coeur d'Alene mining district will be acquired.

Roof Support Systems

40. Inorganic Grout for Coal Mine Roofs

Objective: Develop practical systems for installing fully grouted coal mine roof bolts with fast-set inorganic cements. Material properties for the inorganic full-column roof bolt systems will be determined, and field tests will be conducted on the water microcapsule and gypsum cement cartridges in selected mines.

41. Effectiveness of Angle Bolting to Support Cutter-Type Roof

Objective: Provide the mining industry with an effective method of supporting cutter-type (shear or snap top) roof using angle bolting.

42. Concrete Crib Design and Field Test and Technology Transfer

Objective: Complete the field demonstrations and evaluation of concrete cribs started in FY 80 and prepare a report on the entire project. Crib load and deflection instrumentation and the physical appearance of the cribs will be monitored and recorded as the longwall excavation proceeds past the demonstration section. Load and deflection data will be compared with the results predicted by the computer finite-element model prepared during FY 79. The

structural stability, performance, and economics of the concrete crib system will be analyzed and compared with those of the wood support system it replaces.

43. Inorganic Grout--Material Study

Objective: Provide a fundamental analysis of hydrocal plaster, quantify chemical and mechanical properties of the hydrocal-water capsule reaction products, and examine the special qualities and problems of the hydrocal-water capsule system for grouting roof bolts.

44. Field Evaluation of Existing and Innovative Roof Bolt Elements

Objective: Complete documentation of comparative bolt properties for innovative roof bolts so that these bolting systems can be evaluated by comparison to standard parameters previously established. Secondly, determine in situ performance of novel bolting systems through in-mine testing.

45. Polymeric Sealants To Stop Shale Degradation

Objective: Conduct field evaluations and surveys using polymeric sealants to prevent shale degradation. A water-based polymeric sealant will be sprayed in two coal mines with followup patching and inspections. Polymeric sealants have been sprayed in two active mines in association with contract H0272008, "Weathering Protection at the Fact." These four mines will be inspected to evaluate effectiveness of the material used.

46. Effects of Bolt Installation Procedures on Mine Roof Stability

Objective: Determine required resin-column length for insuring integrity of resin-grouted bolts, evaluate the E & MR ultrasonic stress device for testing resin-grouted bolts, and complete the evaluation of the effects of installation procedures on resin-grouted bolts.

47. Mine Roof Stabilization Using Inorganic Chemical Bonding

Objective: Develop chemical binders and methods of application to mine roofs to increase the mine roof stability with special attention given to potential inorganic binders.

48. Evaluate Support Wall Systems

Objective: Determine the stability characteristics of various pack wall materials and pack systems in place. Standardized tests required to establish materials characteristics will be determined, test program guidelines will be tested to determine the overall performance ranges of a pack, and procedures will be established by laboratory and in-mine trials to evaluate pack competence. Packwalls will be tested at Mid-Continent Resources, Inc.'s No. 1 and No. 3 Mines. Laboratory tests will be performed at the Bureau's Spokane Research Center to establish in situ testing capabilities. Both laboratory and field test of fill-in wood cribs will be conducted.

49. Mine Support Wall Material Test

Objective: Determine optimum mine support wall materials formulated using coal and/or coal waste aggregates.

50. Steel Support Study

Objective: Improve the design, handling, and installation of steel supports to insure that supports are used properly according to ground conditions and to reduce the accidents associated with handling by workers.

51. Coal Mine Roof Deflection Analysis

Objective: Devise a method of using the deformation characteristics of a coal mine roof to establish the nature of the immediate roof and the type and amount of support required to insure safety for miners.

52. Cost-Effective Expendable Instrumentation

Objective: Develop a handbook on instrumentation that will provide guidelines for the selection of the least expensive instrumentation capable of performing to collect the required data, and has the potential of reducing the cost of research instrumentation by 20 percent.

53. Inorganic Grouted Rock Bolts

Objective: Develop an inorganic grout system suitable for the large bolt holes commonly drilled in metal and nonmetal mines. The initial task will be to identify reasons for poor anchorage of small-diameter bolts grouted in large-diameter holes. Pull tests will be made with different size rebar grouted in holes drilled in concrete blocks with a 1-3/8-inch drill (commonly used in metal and nonmetal mines).

54. Ground Support Systems--Block Cave Mining

Objective: Design, test, and implement better methods of support for grizzly drifts and haulage crosscuts in block cave mining; and install, line, and backpack a haulage crosscut at the Sacaton unit of ASARCO, Inc.

55. Laboratory Test Program for Long Hole Bolting

Objective: Laboratory test the longhole bolting prototype (tube bolt) developed during FY 80-81.

56. Rock Bolting Prior To Blasting in Conventionally Driven Raises

Objective: Provide miners with temporary roof support while conventionally driving raises. The procedure is to drill a hole 4 feet longer than the round and then install a 4-1/2-foot resin-grouted rock bolt. Following the blast, about 6 inches of the bolt remains exposed and a "head board" is added by to provide support above the miner's work place.

Safe Support Installation

57. Determination of Decay in Mine Timber

Objective: Test the timber decay system developed under contract H0202009 to evaluate the effectiveness of the instrument to determine the strength loss of rotted timber.

58. Field Test of ATRS for Single Head Roof Drill

Objective: Provide the mining industry with complete information to enable fabrication of a tested automated temporary roof support (ATRS) for single, fixed-head roof drilling machines (squirmers).

59. Control-Prevention of Ignitions From Light Metals Impact

Objective: Determine the feasibility of alloy modification and/or protective coatings on mining equipment made of aluminum alloys to prevent or retard ignition potential. Determine the causes of ignition-inducing reaction arising from the rubbing impact of light metals and steels.

60. Underground Testing of the 4M Miner

Objective: Evaluate the health, safety, and production merits of the miniminer system under normal production conditions. An underground demonstration of the miniminer system should begin in FY81 and continue through the early portion of FY 82. The data that will be collected will be primarily used to validate the information collected during the surface testing of the miniminer system.

61. Field Test and Modification of Lightweight Hydraulic Props

Objective: Complete long-term field testing of lightweight props and modify, if necessary, to improve the safety of handling and support functions in various seam heights and mining conditions.

62. Computer Organization of Single-Entry Data

Objective: The raw data from the coal mine single entry study will be reduced, transformed, and published as a Report of Investigations.

63. Preparation of Longwall Support Selection Guide

Objective: Prepare for the mining industry a guide for selecting the optimum longwall support system for a particular set of mining conditions.

64. Retreat Mining Methods--Field Study

Objective: Identify changing ground conditions during various retreat mining operations and provide guidelines for uniform safety practices during retreat mining by FY 85. Instrumentation will be installed at two sites during development and retreat mining to monitor stress patterns and convergence during the various mining sequences. Observations and mine inquiries will be made along with instrument monitoring at the test sites to gain a better understanding of the ground conditions, method of operation, and hazards associated with retreat pillaring operations.

65. Technology Assessment-Forecasting for Ground Control

Objective: Examine Health and Safety Analysis Center data on falls of roof-rib so that conclusions can be drawn relating conditions and circumstances contributing to accidents and fatalities.

66. Equipment Evaluation

Objective: Develop mechanical, hydraulic, and electrical in-house expertise for in-house research and contract monitoring. Develop a laboratory and equipment base for further in-house work and proper contract monitoring.

67. Backfill Material for Tunnel Liners

Objective: Test and write specifications and recommendations for the use of backfill material (in conjunction with specific linear geometry) that is used to insulate tunnel liners from the impact loading of roof falls through the absorption of energy and redistribution of loads.

68. Metallurgy Evaluations

Objective: In coordination with MSHA Technical Support, establish and maintain a program at the Bureau's Rolla Research Center for metallurgical evaluation of roof-rock bolts and other steel supports.

69. Corrosion of Metallic Roof Support Elements

Objective: Develop guidelines to aid MSHA and mining personnel in predicting the life of roof support systems, determine detrimental effects of corrosive mine environments on friction rock stabilizers (split set), and help identify potential control measures.

70. Improved Roof Sounding Techniques

Objective: Develop a piece of hardware that can be easily used to determine the competency of roof rock in mines. This device may either be incorporated in a scaling bar or a stand-alone device. An initial prototype device is intended by the end of FY 82.

71. Scaling Technology

Objective: Develop a safer, more effective, and less strenuous means of scaling mine roof and ribs by testing, analyzing, and modifying, if necessary, scaling tools developed from previous contracts.

Mining and Minerals Processing Waste Stability

72. Evaluation of Filter Cloth for Stabilization of Coal Mine Waste

Objective: Provide safer, longer lasting dams of coal mine waste materials through the use of filter media to control seepage. The immediate objective is to evaluate criteria for selection of filter cloth and test the filters under simulated mine waste dam environments. Also, evaluate the deterioration of the cloths by sunlight and chemicals used in coal preparation plants and investigate possible unidirectional flow in some filter cloths.

73. Mixing Coarse-Fine Coal Wastes

Objective: Determine the best mixing ratios of coarse and fine coal refuse to achieve the maximum fill strengths for surface disposal. Document disposal practices at selected coal preparation plants including coal preparation techniques versus mining techniques, waste product amount and sizes, strength characteristics of consolidated fine refuse, moisture contents of consolidated fine refuse, and transportation techniques for disposal of the refuse.

74. Disposal of Wastes Over Active Underground Mines

Objective: Develop design and construction criteria for safe disposal of mine waste over active underground mines by evaluating geologic features, type of mining system used, extraction ratio, and pillar design. Peripheral conditions such as landslide potential, probable safety features such as placing of wastes to allow self plugging in the event of minor subsidence, and physical properties of the different types of mine waste will also be evaluated for their impact on underground workings.

75. Use of Infrared Scanners To Detect Water Levels in Waste Embankments

Objective: Test the use of infrared thermography on coal waste embankments to determine water levels within the embankment, and structural integrity. Seasonal changes in water levels will be tested using an infrared scanner. The results will be analyzed and compared with piezometer readings.

76. Ground-Aerial Inspection of Surface Coal Waste Disposal Sites

Objective: Coordinate ground surveys to be performed under companion contract project inspection procedures and write the final report concentrating on the effectiveness of aerial photogrammetry as a practical tool for mine waste disposal site inspection.

77. Consolidation of Coal-Clay Waste by an Improved Flocculation Technique

Objective: Demonstrate the technical feasibility of using an improved flocculation technique to dewater waste coal sludge generated in coal preparation plants to produce a consolidated, stable waste material that can be safely disposed of. A field test unit will be operated at a cooperating coal preparation plant at the rate of 300 to 500 gpm. The feasibility of mixing dewatered coal sludge with coarse coal refuse material for long-term stabilization of waste products will also be determined.

78. Field Test of Microseismic Monitoring of Waste Dams

Objective: Apply the information gained by a previous contract, which defined the basic characteristics of some parameters involved in microseismic monitoring of waste dams under controlled conditions, to a field installation and actual monitoring conditions.

79. Analytic Techniques--Waste Disposal-Tailings Embankment Design

Objective: Investigate and develop mathematical, statistical, and probablisitic techniques relative to tailings embankment design. Focal areas for FY 82 include factor of safety risk analysis and centrifuge modeling. When appropriate, perform field studies to verify theoretical assumptions.

80. Compaction Criteria for Metal-Nonmetal Waste

Objective: Determine the compaction characteristics of metal-nonmetal tailings. Optimum layer thickness, densities, and compactive effort will be developed on an operating waste embankment.

Industrial-Type Hazards

Program Objectives: To (1) limit the possibility of human error through training, and human-machine and human-environment interfacing; (2) improve equipment design and controls; (3) detect and prevent failures of electric circuitry and hardware; (4) provide adequate lighting in working areas; (5) insure continuous and reliable communication between all underground and surface mine personnel, while providing continuous surveillance of the mine environment; and (6) improve safety in haulage and materials-handling operations.

Human Factors

1. Human Factors and Industrial Safety (Education and Training)

Objective: In-house efforts in FY 82 will serve to coordinate a diverse mixture of current research projects according to well-defined short- and long-term research objectives. These objectives include development of performance criteria, instructional strategies, and evaluational methods for mine health, safety, and occupational training; application of current learning technology to investigate the potential of utilizing training equipment to enhance and economize classroom and on-the-job training.

2. Human Factors and Industrial Safety (Ergonomics)

Objective: When mining accidents are thoroughly investigated, it is often found that "human error" or management oversight is the primary contributing factor. Some mining authorities maintain that perhaps 80 percent of all accidents and injuries are the results of human error. This explanation alone offers little opportunity for application of appropriate countermeasures. If human error type accidents are to be significantly reduced, the work environment, including machines, must be designed in a manner that permits the fewest possible errors to occur. Secondary to appropriate workplace design is adequate training of miners and management. This in-house effort involves tasks which are oriented toward either solving specific human factor problems in the mining industry or supporting a broad range of efforts directed toward reducing mining accident and injuries associated with human error.

3. Surface Mine Training

Objective: Develop information and strategies to aid mining companies in administering and monitoring their efforts to improve safety training effectiveness in mining and mineral processing operations.

4. Feasibility Study on the Use of Visual Skills Training in Hazard Recognition for Underground Mines

Objective: To investigate the potential for training new miners utilizing various simulation techniques to develop visual search and discrimination skills for recognizing dangerous and safe roof and rib connections.

5. Computerized Index of Available Training Material

Objective: To develop a computerized index of training material and aids available from the Bureau of Mines, U.S. Department of Energy (DOE), MSHA, State and local agencies, companies, uions, safety trade associations, and academic institutions. The index will be made readily accessible through terminals at MSHA training centers and other locations.

Electrical

6. Intrinsic Safety

Objective: To investigate research problems related to a basic understanding of intrinsic safety, supply technical support to Bureau contractors and researchers and to work with national and international committees in developing recommendations and standards for using electrical equipment in potentially explosive atmospheres; and to improve the quality of Bureau equipment and personnel training.

7. Acceptance Criteria for Nonejectable Cap Lamp Bulb

Objective: To develop an acceptance guideline (including test methodology and failure criteria) for nonejectable cap lamps.

8. Explosion-proof Enclosures

Objective: (1) To determine minimum safe electrical clearances between uninsulated live conductors used in explosion-proof enclosures for voltages greater than 2,000 volts. (2) To investigate the mechanisms by which high-power arcs affect internal pressures in potted explosion-proof enclosures.

9. Electrical Equipment, Devices, and Systems

Objective: To conduct preliminary investigation and final evaluations relative to contracted research and design tasks in the field of mine electrical systems and devices, and to pursue in-house basic research for the general improvement of metal and nonmetal mine electrical safety.

10. Handbook for Electrical Grounding Safety for Small Pits and Quarries

Objective: Produce a handbook for field use, "A Practical Field Guide for Metal and Nonmetal Mining Electrical Grounding Safety for Small Pits and Quarries."

Equipment

11. Development of Technology To Reduce Equipment-Related Accidents

Objective: To define future equipment-related research needs and to advance the level of health and safety technology in a variety of equipment areas that have already been identified as accident problems. This objective will be achieved by conducting a cohesive research program balanced between the optimization of current mining equipment design for improved safety in the short-term and the identification and development of innovative underground mining technology that will eventually eliminate the presence of miners in the hazardous face area.

12. Surface Mine Equipment Safety

Objective: Develop and in-mine test mine vehicle safety hardware in the areas of operator ingress-egress systems, driver alertness, and vehicle retrieval.

13. Participation on the Society of Automative Engineer Technical Committee on Mining Equipment (SAE Subcommittee 29)

Objective: Develop standards that cover requirements for safeguarding life and property on underground and surface coal, metal, and nonmetal mining equipment.

14. Operator Protection for Surface Mining Equipment

Objective: To test operator acceptance of improved seat belt systems for mobile surface mining equipment, and to develop novel methods of operator protection. Also, evaluate the state-of-the art of fire-resistant fluids' performance and equipment compatibility in coal mining equipment through industry contacts.

15. Processing Plant Equipment Safety

Objective: To investigate the application of safety technology to reduce equipment hazards at processing plants.

16. Assessment of the Role of Mining Equipment Rebuild Shops in the Bureau of Mines Technology

Objective: To study, evaluate, and optimize the role of equipment rebuild shops in transferring the results of Bureau research into industry practice. The initial pilot effort, to be accomplished this year, will culminate with the preparation of a directory of underground coal mining equipment rebuild shops located in Pennsylvania that identifies the range of services and capabilities available.

17. Modification and Demonstration of an Improved Circular Kerf Cutting Machine

Objective: To improve and demonstrate the potential benefits of a novel kerf cutting machine that had been developed under a previous Bureau project. This machine bores a large round hole in the center of the coal face in conventional mines. The explosive charges cause the coal to expand and fracture inward instead of downward, thus causing a completely different dust and lumping characteristic. The machine had been built, but was never fully debugged and demonstrated. It is believed that a considerable reduction in airborne dust loads from conventional mining can be achieved with this method of kerf cutting. By reconditioning this machine, an evaluation of its safety and functional operating characteristics can be made at the surface test facility using artificial coal blocks.

18. Characterization of Material Failures in ROPS

Objective: Define and characterize the service life of rollover protective structures (ROPS) on large surface mining equipment.

19. Machinery Maintenance Related Accidents

Objective: Based on an investigation of machinery maintenance related accidents, develop concepts for improved maintenance tools and procedures.

20. Collision Protection

Objective: Develop, laboratory test, and in-mine on-vehicle test prototype hardware that reduces the vehicle collision hazards in surface mines. Work will involve low profile, fresnel lens, blind area viewers, improved truck mirrors, and close-in hazard detection devices.

Illumination

21. Illumination Research

Objective: (1) Evaluate specialized power supplies and lighting hardware for diesel-powered surface mining machinery. (2) Maintain and update the machine-mounted permissible illumination systems in use in the Bruceton Experimental Coal Mine. (3) Investigate the illumination of surface mining equipment. (4) Investigate the feasibility of flexible lighting systems that are radio frequency excited. (5) Provide technical assistance to MSHA and the mining industry.

Communication-Monitoring

22. Performance Standards and Systems Approach to Mine Monitoring

Objective: To conduct preliminary investigations, maintain a base of knowledge, and provide support for the mine monitoring program. Individual problems in the area of mine monitoring will be investigated by in-house expertise, particularly those discovered through contact with MSHA personnel and those that become evident as newly developed monitoring systems are field tested. Areas of study are systems performance evaluation, developing performance standards, and security of data transmission.

23. Underground Communication Systems

Objective: To continue basic and applied research in the areas of hardwire and wireless radio systems for underground mines.

24. Mine Telemetry and Environmental Surveillance System-Coal

Objective: To design, procure, laboratory test, and in-mine evaluate mine monitoring systems in candidate coal mines; and to develop an intrinsically safe monitoring system specifically to support in-mine demonstration project currently ongoing.

25. Mine Telemetry and Environmental Surveillance System--Metal-Nonmetal Mines

Objective: To support mine monitoring systems that are installed in candidate metal-nonmetal mines. Specifically to evaluate, maintain, and improve as necessary by the mine monitoring system installed in the Black River Mine.

Haulage Material Handling

26. Materials Handling Equipment Development

Objective: Investigate methods by which mine materials handling activities can be made safer and less labor intensive. Project areas include the handling of supplies and machine components and emergency braking devices for tracked vehicles on slopes. In addition, there is an ongoing effort involving statistical analysis of accident data in support of contractual efforts in this area.

27. Operation of the Wire Rope Test Facility

Objective: To define the characteristics of wire rope and its uses that affect the life of mine hoist and haulage rope. To perform detailed analyses and testing of new and retired ropes and monitor field use. To relate the results to manufacturing procedures, rope construction, or in-service procedures to improve the performance and safety of wire rope used in mining.

28. Laboratory Analysis of Wire Rope

Objective: To define physical and chemical characteristics of wire rope that affect rope degradation in mine hoisting, and to define mechanisms of hoist rope deterioration that result in rope removal from service. Data will be assembled and used to determine the most important modes of degradation, and the ability of current inspection techniques to detect both the degradation and to evaluate the remaining rope strength and fatigue life. The information will be used to recommend improvements to the regulations and to plan future research.

29. Pneumatic Transport Safety Designs

Objective: To assess the safety liabilities and assets of pneumatically transporting coal both horizontally and vertically, to compare these results with the safety of conventional methods of underground coal haulage such as shuttle cars and skip haulage, and to report the results in both an Information Circular and industry publications.

30. Conveyor Safety

Objective: To support development of a conveyor safety program by conducting background investigations of potential research areas and promoting technology transfer of completed projects by preparing journal articles, Information Circulars, making presentations at industry conferences, etc.

31. Analysis of Materials Handling Accidents in Underground Mining

Objective: To collect and analyze available data on materials handling accidents. This program will be based upon accident data obtained from MSHA, industry, and foreign files; risk measurements of the data; discussions with coal operators and workers, safety associations, MSHA personnel, mining and safety equipment manufacturer; and studies of actual materials handling operations in the field.

32. Analysis of Equipment, Haulage, and Material Handling Accidents in the Mining Industry

Objective: In cooperation with the Bureau's Spokane and Pittsburgh Research Centers, investigate the causes of equipment, haulage, and materials handling related accidents to provide a sound foundation on which to base a cohesive, coordinated industrial hazard safety research program.

33. Operational and Maintenance Safety Analysis of Large Mine-Run Rock Conveyor

Objective: To evaluate the safety of the large rock conveyor system, both operational and maintenance safety; outline areas of design and operational changes to promote maximum safety; and determine areas where additional research is needed.

Postdisaster

Program Objectives: To develop technology that will (1) enable survivors of a mine disaster to escape from the mine or to continue to survive while awaiting rescue by providing protection against toxic and/or oxygen-deficient atmospheres; (2) aid in the location of miners trapped underground, using seismic and electromagnetic means of communication; and (3) facilitate postdisaster rescue and recovery operations through surface monitoring of conditions underground, emergency communications, and mechanized transport and life-support equipment for mine reentry and rescue operations.

Survival

1. Human, Machine, and Environmental Tests of Breathing Apparatus

Objective: To improve breathing apparatus by testing prototype and commercial breathing apparatus and reporting results and recommendations of evaluations to manufacturers.

2. Advanced First Aid, Health, and Fitness Studies

Objective: To conduct studies in the needs and application of advanced first aid, health, and fitness topics to improve life support and survival of miners.

3. Advanced Breathing Apparatus Design

Objective: To study needs and perform research and development of novel breathing apparatus designs and components, and effect or stimulate long-term improvement in apparatus design.

Communications

4. Trapped Miner Location and Communication

Objective: To develop emergency detection and location systems for postdisaster rescue efforts, evaluate hardware for these rescue efforts, and provide technical assistance to contractors conducting field test programs.

5. Short Range Locator

Objective: To develop and demonstrate a system to quickly and accurately locate trapped miners underground to enhance their chances of survival in postmining disasters.

6. Development of Trapped Miner Location System Using Phase Difference of Arrival Techniques

Objective: Determine the feasibility of using "phase difference of arrival concepts" (PDOAC) to develop an electronic system for locating trapped miners.

Rescue and Mine Recovery

7. Improved Rescue Technology and Personal Protective Equipment for Mine Rescue

Objective: To study the needs of the mining industry and propose applications of new or existing rescue technology to meet those needs and to stimulate research and development of personal protection equipment for mine rescue.

Explosives

Program Objectives: To assess the problems associated with the safe and effective use of explosives in all types of mining activity including fixed explosives, blasting agents, blasting devices, and blasting accessories. To conduct fundamental studies of explosive behavior and apply the results in the development of new technology. To develop new and improved test procedures as new types of explosives are formulated.

Explosives and Blasting

1. Development of Guidelines and Supporting Tests for Standards and Enforcement

Objective: (1) To provide supporting research for accident investigations and on potentially hazardous situations or products, or practices identified by MSHA, (2) to recommend guidelines based on research for the development-revision or enforcement of safety standards in the areas identified.

2. Determination of Permissibility Requirements for Blasting in Noncoal Mines

Objective: To develop information based on experiments to be used for the development of guidelines and standards for nonincendive explosives and blasting agents and permissible blasting practices in oil, oil shale, and other noncoal mines having a potential gas or dust explosion hazard.

3. Methods of Reducing Accidents Caused by Misfires

Objective: To examine factors associated with accidents caused by misfires. These factors would include causes of misfires, methods of detection, and techniques for disposing of misfires. Recommendations will be made for preventing misfire accidents.

4. Development of Improved Blasting Machine Tester

Objective: To develop a blasting machine tester that, in addition to the capabilities of currently available testers, can detect energy losses through parallel resistance faults, stray potentials on the blasting machine case, and determine the adequacy of the energy output relative to the energy requirements of the blasting circuit. When the number of detonators per series, the number of series in parallel, the energy requirement per detonator, with compensation for lead resistance are "dialed in," the tester will determine whether the blasting machine can reliably fire the particular circuit.

5. Hazards of Explosives and Explosive Devices

Objective; To provide MSHA and the mining industry with information, guidelines, and/or recommendations in the area

of sensitivity, reactivity, energy release, and reliability of blasting materials subjected to various normal or abnormal mechanical, electrical, and thermal stimuli, as well as evaluations of blasting accessories in connection with MSHA accident investigations or development and/or revision of safety relative to these materials and their use. Development and/or updating of tests and procedures is also an important part of the objective.

6. Permissible Explosives--Evaluation and Research

Objective: Continue evaluating explosives and explosive devices for underground coal mine use, as required by law, monitor of field samples for conformance with their basic specifications, perform the necessary research to improve the safety and performance of coal mine explosives, including water gel and water emulsion permissibles, examine all explosives reportedly involved in accidents or incidents, and report findings to MSHA.

7. Fire Hazards of Explosives and Blasting Agents

Objective: To complete all development, optimization of parameters, and gathering of supporting data in connection with Bureau efforts to develop laboratory-scale size thermal tests designed for use in making assessments for minimizing fire hazards of explosives and blasting agents in storage or transit at mine sites.

8. Improvement of Nonincendive Explosive Charge for Unconfined Shooting

Objective: To reduce the weight and profile of the nonincendive charge previously developed, research the effects of the shape and packaging of the explosive charge on rock-breaking efficiency, improve understanding of the mechanism by which the flame inhibiting material operates.

9. Development of New Schedule Tests and Standards

Objective: Update current and develop new schedules and standards as needs arise for permissible explosives and related articles, recommend changes to MSHA for the purpose of providing safer and more effective explosives and devices, extend basic knowledge by investigating mechanisms involved in and associated with incendivity and performance of explosives, including the United Kingdom and West German ultrasafe explosives.

10. Basic Research on Initiation and Propagation of Detonation

Objective: To formulate explosive criteria that reflects the interrelationship of explosive characteristics, explosive states, stimulation mechanisms, and reaction modes of mining explosives which are characterized as water-gels or gelatinous.

11. Analysis of Coal Mining Blasting Accidents

Objective: This project will analyze coal mine blasting accidents to insure that the Bureau research effort is directed toward the real causes of blasting accidents and includes a minor effort devoted to analysis of metal and nonmetal mine accidents.

Systems Engineering

Program Objectives: To develop methods for evaluating the impact of specific technological improvements or inadequacies on the total mining and minerals processing operations and identifying problems whose solutions would provide the greatest health and safety benefit. To operate and maintain underground research and test facilities for use in testing and demonstrating new procedures and equipment before they are tested in commercial mines.

Systems Analysis

1. Hazard Analysis of Underground Mining--Methane, Roof Falls, and Fires

Objective: Develop recommendations for new technology or modifications of current technology to reduce the roof fall hazard to personnel making methane measurements at the coal face. Identify and analyze major fire problem areas in gassy noncoal mines. Quantify equipment operational parameters in surface and underground mines and specify component performance requirements to assure reliable operation of safety systems.

2. Application of Mine Safety Hardware

Objective: Identify significant applications of mine safety hardware developments. Determine the cost-effectiveness of specific mine safety hardware developments. Demonstrate the effectiveness of safety devices through in-mine tests.

3. Information Retrieval System for Costs of Mine Accidents and Application

Objective: The ultimate goal is to provide information to management and researchers for making decisions. The objectives of this proposal are to (1) convert the 1979 and 1980 Health and Safety Analysis Center (HSAC) accident statistics into cost statistics; (2) identify these data; (3) simplify run procedures on 1979 and 1980 HSAC accident statistics so any interested person may conduct the online retrieval and analysis; (4) conduct correlation statistics among various accident statistic and mine characteristics, that is seam height; (5) identify useful information that can be obtained from the data and methodologies apply the technique to real situations, and extract information from the mine accident data bases by applying the latest statistical techniques designed for categorical data (a characteristic of some of the mine accident data).

4. Statistical Accident Analysis and Literature Search

Objective: The objectives are to formulate a method for measuring risk (safety) of mining operations; to derive risk values using HSAC accident data and foreign data; to use these risk values to rank the hazards of different mining activities; and, through literature searches, to summarize past research, identify past and current trends, and aid in planning future research projects.

5. Analysis of Mining Systems

Objective: To examine, select, process, and package pertinent research results related to coal mine health and safety involving methane control and method for prediction of roof instabilities to effectively integrate them into the total mining system. To identify technology gaps in research.

Test Facilities

6. Operation of Underground Test Facilities

Objective: The objective is to operate the two experimental mine facilities located at Bruceton for the purpose of supporting ongoing research and development projects. Examples of project activities scheduled for work in the mine facilities include construction and testing of explosion-proof bulkheads, trickle duster testing in return air courses, coal and oil shale fire tests, reduction of respirable dust generation by coal cutting equipment, and ground control instrumentation tests.

7. Operation of Lake Lynn Laboratory

Objective: To operate the Lake Lynn Laboratory in support of ongoing Bureau of Mines programs. Examples of programs to be pursued include testing new types of explosion barriers or ignition-suppression devices, diagnosis and abatement of methane roof layers, minimum initiation conditions for dust explosion, and explosion and hydrostatic testing of candidate explosion-proof bulkheads and water seals.

PART II.--CONTRACT RESEARCH

Health

Respirable Dust

Program Objectives: To develop procedures for controlling the respirable mine dusts that still constitute the severest health problem facing the mining and minerals processing industries. To develop and/or improve techniques and equipment to prevent formation of hazardous dust concentrations and to protect miners against dusty atmospheres.

Control of Dust Formation

1. Instrumented In-Mine Testing of the Bureau of Mines Low-RPM, Deep-Cutting Continuous-Mining Machine

Objective: To determine specific forces and their magnitude encountered during mining of coal with an instrumented, deep-cutting, continuous-mining machine. This information shall be made available to the mining equipment industry to design and construct production versions of the low-rpm, deep-cutting continuous-mining machine. This is a continuation of an ongoing effort.

2. Effects of Continuous-Mining Machine Operator Variables on Dust Generation During Coal Cutting

Objective: To define operator variables and determine the effect of controllable operator variables on primary dust generation during coal cutting with continuous-mining machines. This is a continuation of an ongoing effort.

3. In-Seam Tester for Underground Coal Mines

Objective: To develop and demonstrate a portable, quick, in-seam tester for determining drum-bit forces required to excavate coal from the face of an underground coal mine heading and to establish correlation of cutting forces between an instrumented miner and the in-seam tester. This is a continuation of an ongoing effort.

Control of Generated Dust

4. Evaluate Longwall Dust Sources and Control Technology

Objective: To define and quantify the relative contribution to the overall dust exposure of each of the major dust-producing elements and processes associated with longwall mining. This is a continuation of an ongoing effort.

5. Conveyor Belt Dust Control

Objective: To reduce the occurrence of respirable dust at conveyor belt loading, dumping, and transfer points by cost-effective dust control systems. The effort shall consist of data collection and analysis, design and fabrication of a dust control system, laboratory evaluation, and in-mine testing and demonstration. This is a continuation of an ongoing effort.

6. Improved Canopy Air Curtain

Objective: To develop an improved canopy air curtain system for mining use, and to investigate the feasibility and develop a method and hardware that will remove gaseous contaminants in addition to particulates from the mine air that will be delivered by the canopy air curtain. Specifically, to investigate the feasibility and design of an air-purification module for use on canopy air curtains used on dieselized equipment in underground mines. This is a continuation of an ongoing effort.

7. Mine Demonstrations of Longwall Dust Control Techniques

Objective: To evaluate the effectiveness of available dust control technology for double-drum shearer longwall sections in a coordinated, systematic program at several longwall test sections, and to make the results available to the entire coal mining industry. These demonstrations should guide the coal mining industry toward the best available technology to control respirable dust with the least adverse impact on coal production. This is a continuation of an ongoing effort.

8. Optimizing Water Sprays for Dust Control on Longwall Shearer Faces

Objective: To test and evaluate water spray systems on longwall faces. To compare an optimized water-spray system with a conventional system formerly in use at a full-scale model longwall face. The optimized system shall be tested in at least five mines. This is a continuation of an ongoing effort.

9. Shearer-Mounted Dust Collector

Objective: To continue to evaluate the effectiveness of water-powered spot scrubbers for use on lonwall mining operations. To optimize its performance and location and conduct underground tests of the improved spot scrubber design. This is a continuation of an ongoing effort.

10. Evaluation of Charged Water Sprays

Objective: To determine and verify the feasibility of using electrically charged water sprays and mists for the control of respirable dust in underground nongassy mines. This is a continuation of an ongoing effort.

11. Design, Develop, and Demonstrate the Use of Hollow and Wet Cutter Bars

Objective: To design, develop, and demonstrate a hollow cutter bar used in conjunction with a machine-mounted dust collection system, and to assess the current effectiveness and optimization of wet bar dust control techniques. This is a continuation of an ongoing effort.

12. Bag Machine Dust Controls and Bag Sealing

Objective: To design and demonstrate an effective bagging machine modification to reduce the liberation of dust as the bag fills and leaves the machine. To further alleviate the dust problem, a positive bag seal is also to be designed and demonstrated. Special emphasis is planned on controlling dust in silica flour mills. This is a continuation of an ongoing effort.

13. Dry Dust Collector

Objective: To design, fabricate, and demonstrate a small, safe, simple, and rugged dry collector that would be suitable for face (including machine mounting), belt transfer, and other mining applications. Evaluate the collector at several mining and mineral processing operations to include a silica mineral processing mill and incorporate any design changes to enhance the performance and application of the collector. This is a continuation of an ongoing effort.

14. Bag Cleaning and Broken Bag Disposal

Objective: To develop techniques and equipment to (1) remove or control dust on the exterior of filled bags;

(2) compress bags to remove internally trapped air; and (3) detect and dispose of broken bags on conveyor circuit at silica processing mill operations. This is a new RFP.

Dust Instrumentation and Measurement

15. Field Prototype Light-Scattering, Machine-Mounted Respirable Dust Monitor

Objective: To develop, fabricate, and test a reliable device that can be mounted in the vicinity of a mining-machine operator that will give the operator a visual signal of the immediate environmental dust level. This is a continuation of an ongoing effort.

16. Personal Dust Exposure Monitor--Light Scattering

Objective: To develop a reliable, sufficiently accurate personal exposure monitor for respirable coal mine dusts. The device shall provide the wearer with a warning when corrective actions are necessary. It shall be of suitable size, weight, and accuracy so that it can replace the personal dust sampler. This is a continuation of an ongoing effort.

17. Respirable Dust Measurement Research, Development, and Evaluation

Objective: To conduct a laboratory evaluation of selected dust measurement instruments, both prototype and those commercially available, to determine precision and accuracy for representative mine aerosols, and to develop calibration procedures for each instrument. This is a continuation of an ongoing effort.

Radiation Hazards

Program Objectives: To develop and provide new and improved radiation instrumentation, measurement, and control technology for protection of miners from exposure to radon and radon daughters and other nuclear radiation hazards in uranium and other mines.

Control of Radiation Hazards

1. Design, Build, and Test an Air-Cleaning System for Working Level Control in Uranium Mines

Objective: To design, build, and test a combined fan and air-cleaning unit for working level control and suitable for ventilating a small work place in a uranium mine. This is a continuation of an ongoing effort.

2. Cost Survey for Radon Daughter Control by Ventilation and Other Control Techniques

Objective: To determine the effectiveness and costs of using dilution control and other methods to meet the existing 4WLM annual exposure standard, and to project the costs and effectiveness of all those control methods in meeting annual exposure standards of 2.0, 1.0, and 0.5 WLM as well as radon-radon daughter mine discharge quantities. This is a continuation of an ongoing effort.

Radiation Instrumentation and Measurement

3. Passive Nuclear Track Dosimeter

Objective: To continue modifications of existing dosimeter design to reflect improvements suggested by in-mine tests. To investigate new designs and concepts to reduce maintenance and contamination of external detector in active mine environments. To conduct verification testing in the laboratory and in the Twilight Mine and active mines. This is a continuation of an ongoing effort.

Noise Control

Program Objectives: To identify noise sources in underground and surface mines and in related mineral processing surface facilities, to abate these noise sources through both field retrofit and factory redesign approaches so that the mining operations and minerals processing activities meet the Federal noise exposure standards, to provide more accurate measurement of the noise environment, and

to provide industry with the technical knowledge necessary to select, design, and implement noise control measures.

1. Noise Study of Longwall Mining Systems

Objective: To develop quieter longwall mining equipment. The noise problems of longwall systems shall be identified, and feasible engineering controls that achieve quieter operation without affecting production shall be assessed and demonstrated. It is anticipated that the demonstration phase will involve a cooperative effort with a longwall equipment manufacturer. The identification and assessment phases were completed in FY 81. This is a continuation of an ongoing effort.

2. Current Levels of Whole-Body Vibrations in Mines

Objective: To determine and assess the present levels of mine personnel exposure to whole-body vibrations and to compare these levels with the results of a medical literature search relating vibration parameters to physiological effects. This study represents the initial background effort in the possible establishment of a program in this area. This is a continuation of an ongoing effort.

3. Abatement of Taconite Plant Noise Sources

Objective: To develop and demonstrate practical engineering noise controls for equipment used in taconite plants. Prior work in this area determined the noise sources in taconite plants and concentrated on secondary crushers. This effort shall be aimed at quieting screens, rodmills, autogenous and semiautogenous mills, pneumatic rappers, and vacuum disk filters. Solutions developed were implemented in selected plants and evaluated to assess acoustic effectiveness, durability, and costs. A report will be published detailing the engineering controls that were implemented and comparing the cost effectiveness of these controls with administrative controls. This is a continuation of an ongoing effort.

4. Retrofit of Underground Load-Haul-Dump Machines With Noise Control Packages

Objective: To develop retrofit noise control technology for specific models of load-haul-dump (LHD) machines. Noise control techniques shall be implemented and in-mine tested. Participation of the contractor with equipment manufacturers and mine operators is considered essential in conducting this contract. This contract is a continuation of ongoing efforts to quiet LHD's through retrofit means.

5. Noise Control of Rubber-Tired Front End Loader Used in Surface Mines

Objective: To provide a series of workshops intended to assist mining personnel in selection, fabricating, and installing retrofit noise control treatments on front end loaders. This is a continuation of an ongoing effort.

6. Development of a Prototype Hand-Held Rock Drill for Use in Metal and Nonmetal Mines

Objective: To develop a reduced-noise hard rock drill for use in the metal and nonmetal mining industry. The basic technology that was successful in the development of a quieter coal mine pneumatic stoper drill shall be applied. This is a continuation of an ongoing effort.

7. Predicting Nonmetallic Screen Deck Performance

Objective: To conduct an extensive screen deck testing program to develop performance information and a computer model for the screening performance of nonmetallic decks. This is a continuation of an ongoing effort.

8. Environmental Testing of Personal Audio Dosimeter

Objective: To environmentally test the reliability and overall performance of commercially available personal audio dosimeters. Commercially available dosimeters will be environmentally tested under various conditions of temperature, humidity, etc., to determine their durability and reliability in a mining environment. This is a continuation of an ongoing effort.

9. Assessment of the Accuracy of Measurement of Dose by Various Instruments in Differing Noise Environments Found in Mining

Objective: To assess the accuracy with which dosimeters, sound level meters, and other devices measure dose under conditions of continuous, fluctuating, intermittent, impulse, and impact noise exposures similar to those found in the mining industry. Information gained in this study will provide a basis for comparing the various methods of dose measurement and point out limitiations and other factors to consider when using a particular instrument under various noise conditions found in the mining industry. This is a new RFP.

10. Noise Control Guidelines for the Coal Mining Industry--Handbook

Objective: To develop a noise control handbook for the coal mining industry. A handbook is being developed that will provide the mining industry with noise control guidelines for mining machines as well as the information necessary for selection, design, and implementation of appropriate control techniques. This is a continuation of an ongoing effort.

11. Integrated Approach to Noise Control for a Continuous Miner

Objective: To develop and field test a noise controlled continuous miner. The intent of this project is to take an integrated approach to noise controlling a continuous miner. Noise control technology that will be developed for the cutting head will be incorporated with previously developed chain conveyor controls and other noise controls into a test bed piece of equipment. The technology will be validated by underground testing.

12. Development of Prototype Production Noise Controlled Jumbo Drills

Objective: To develop a cost-effective, manufacturable, quiet jumbo-mounted drill through redesign. A preproduction prototype jumbo drill is to be designed, fabricated, and field tested. This is a continuation of an ongoing effort.

Industrial Hygiene (Toxic Substances)

Program Objectives: To identify and control health hazards in surface and underground mines and mineral processing plants caused by toxic and/or noxious gases and fumes, and certain particulates produced by explosives, combustible materials, and diesel engines. To develop and evaluate new instrumentation, methods, and procedures for monitoring these substances. To analyze alternative power sources that may have health advantages over existing mine diesels.

Toxic Gases and Materials

1. Determination of the Products of the Oxidative Thermal Degradation of Mine Materials

Objective: To determine the identity and quantity of gas, fume, and smoke products generated during the stages of oxidative heating of materials used in mining. Preignition heating, pyrolysis devolatilization, flaming and glowing combustion, and extinguishment are being investigated. This is a continuation of an ongoing effort.

2. Toxic Fumes From Explosives Tests in Underground Mines

Objective: To determine the presence of trace toxic products such as nitrosamines and others that may be present along with the expected products CO, CO_2, NO_x, SO_2, and NH_3 in the fumes from explosives fired at the working face in a mine. Results will be used to characterize the transient nature of fumes generated during blasting, and to compare these in-mine results with results obtained by laboratory test methods. This is a continuation of an ongoing effort.

3. Monitoring of Mine Air Pollutants

Objective: To develop and test engineering approaches for the control of mine air quality. To characterize exhaust gas distributions in various ventilation configurations in deadend drifts. To evaluate exhaust control hardware in simulated and real conditions. To investigate methods to identify diesel soot on respirable dust filters. This is a continuation of an ongoing effort which involves participation of a cooperating mine.

4. Technique for Determining Efficiency of Sorbents in Diffusion-Type Samplers

Objective: To investigate the feasibility for determining both the efficiency and capacity of diffusion type passive samplers for contaminant gases, and to apply techniques developed to assess mine air quality when diesel-powered equipment is being used. This is a continuation of an ongoing effort.

Diesels

5. Control of Diesel Exhaust In Mines--Aftertreatments

Objective: To develop and field test an exhaust emission control system for diesel-engine-powered equipment suitable for underground mining applications. Combinations of emission control methods including exhaust gas recirculation, catalytic converters, particulate filters, and water-fuel emulsification will be investigated to determine the optimum combination for mining vehicles. The final combination will be field tested. This is a continuation of an ongoing effort.

6. Control of Diesel Exhaust In Mines--Fuel Modifications

Objective: To investigate the control of diesel exhaust emissions by fuel modifications that can be made at the mine site. Specifically, water-fuel emulsifications will be evaluated and optimization of the engine operating parameters to combust these fuels will be performed. This is a continuation of an ongoing effort.

7. Relationship of Underground Diesel Engine Maintenance to Emissions

Objective: To establish mine maintenance and equipment use patterns and relate them to rates of engine deterioration and emission levels. In-service diesel units shall be assessed with laboratory-quality emissions and diagnostic instrumentation. Fuel, coolant, and lubricating oil will be analyzed for contamination. Catalytic reactors shall be evaluated for conversion efficiencies. This is a continuation of an ongoing effort.

8. Development of a Clean Internal Combustion Engine for Underground Mining Machinery

Objective: To evaluate a diesel-metal hydride power source (a diesel engine modified to burn hydrogen) for use in underground mining equipment from the standpoint of mine safety, technical feasibility, industry acceptance, and economics. Hydrogen fuel will be stored in a metal-hydride lattice. To design a program leading to construction of a

prototype and subsequent demonstration of such a vehicle should it be warranted. This is a continuation of an ongoing effort.

Ventilation

Program Objective: To develop ventilation systems required to maintain a safe and healthful atmosphere conducive to efficient work output in noncoal mines.

1. Rigid Foams for Constructing and Repairing Mine Stoppings

Objective: To investigate rigid foams, including urethanes, for constructing and repairing mine stoppings. Chosen foams will be evaluated based on their ability to adhere to material found in mines, to form an effective air barrier, and to present no flame or toxic hazard. Final foams chosen will be in-mine tested. This is a continuation of an ongoing effort.

2. Testing Jet Fans in Mines With Large Cross-Sectional Airways

Objective: To develop guidelines for the proper placement of jet or secondary fans in underground drifts to assure effective ventilation airflow. Ventilation airflow patterns will be assessed under actual in-mine conditions by use of a tracer gas. Different fan placements will be evaluated under varying ventilation conditions in mines with cross-sectional areas up to 20 by 50 feet. This is a continuation of an ongoing effort.

3. Optimization and Testing of Water-Spray Coolers

Objective: To optimize the presently available 5,000-cfm water-spray cooler to assess its potential for larger cooling capacity operation. To investigate new and improved direct-contact, air-water heat exchangers for cooling the hot working areas of deep mines. This is a continuation of an ongoing effort.

4. Water Turbine Energy Recovery System

Objective: To design, develop, and test a fluid motor system that takes energy from the high-pressure water flowing in vertical pipelines in deep hot mines and converts this energy into useful mechanical or electrical energy. This is a continuation of an ongoing effort.

Safety

Fire and Explosion Prevention

Program Objectives: To reduce the potential for fire or explosion in mineral extraction and processing operations; to minimize the danger to people on account of fires or explosions that do occur.

Prevention Research

1. Surface Facility Explosion Hazards

Objective: (1) To develop an accurate understanding of the extent and nature of the fire and/or explosion hazards in surface facilities that clean, crush, process, dry and transport coal, or otherwise use or generate coal, coal dust, or other flammables during minerals processing; (2) to develop an acquisition methodology, and to obtain the safety engineering data base necessary to set realistic standards and regulations for such facilities. This is a continuation of an ongoing effort.

2. Analysis of Fire Safety Tests and Standards

Objective: To analyze current regulatory tests, establish standard test procedures, and recommend regulatory changes. This is a continuation of an ongoing effort.

3. Explosion Hazards of Oil Shale Mining and Processing

Objective: Conduct field tests and surveys in operating oil shale mines to assess methane and dust hazards, explosion hazards of in situ and surface retorting of oil shale, and conduct laboratory tests and sample analyses as appropriate. This is a continuation of an ongoing effort.

4. Fire Hazards of Oil Shale Mining and Processing

Objective: Conduct field tests and surveys in operating oil shale mines to assess methane and dust hazards, fire hazards of in situ and surface retorting of oil shale study spontaneous combustion of oil shale and conduct laboratory tests and sample analyses as appropriate. This is a continuation of an ongoing effort.

Suppression Research

5. Frictional Ignition Suppression by the Use of Shearer Drum-Mounted Sprays

Objective: Investigate the effectiveness of water sprays for suppressing frictional ignition with chisel-type bits. This is a continuation of an ongoing effort.

6. Underground Electrical Installation Fire Protection

Objective: To develop structural and fireproof guidelines for electrical equipment installations that meet the requirements of Section 75.1105, CFR 30. This is a new RFP.

Propagation Research

7. Fire Protection for Plastic Stacks in Mine Shafts

Objective: To perform fire experiments in laboratory-scale shafts to (1) develop optimum means for prevention, suppression, and extinguishment of mine shaft fires; and (2) establish scaling laws for mine shaft fires. This is a continuation of an ongoing effort.

8. Large-Scale Gallery Testing To Establish Fire Hazards

Objective: To operate a large-scale fire gallery for evaluating the relative effectiveness of fire safety measures in metal and nonmetal mines, and to recommend improvements in mine safety and fire regulations based on results of fire trials. This is a continuation of an ongoing effort.

Detection, Instrumentation, and Alarm Research

9. Pneumatic Fire Detection System for Underground Conveyor Belt Haulageways

Objective: To determine the performance characteristics of a pneumatic fire detection system under normal mine operating conditions. This is a continuation of an ongoing effort.

10. Evaluate the Feasibility of Remotely Measuring Methane

Objective: To fabricate a prototype instrument for remotely measuring methane concentrations. This is a continuation of an ongoing effort.

11. Demonstration of a Mine Shaft Fire and Smoke Protection System for Coal Mines

Objective: This cost-sharing, follow-on work will extend the duration of in-mine testing of the prototype hardware and modify it for lower maintenance. This is a continuation of an ongoing effort.

12. Improvement of Coal Mine Dust Incombustible Content Analyzer

Objective: To implement improvements in design and construction of a coal mine dust incombustible content

analyzer, as warranted by testing the present prototype in FY 81. This is a continuation of an ongoing effort.

13. Multilevel, Deep Shaft Fire Detection

Objective: To evaluate and field test a pneumatic fire detection system for multi-level shafts. This is a continuation of an ongoing effort.

14. Improvement of Coal Mine Dust Incombustible Content Analyzer

Objective: To continue development of an alternative incombustible content meter. This is a continuation of an ongoing effort.

15. Poisoning of Catalytic Methane Sensors

Objective: To determine catalytic poisons for methane sensors and to test methods of protection of the sensors for improvement of operational reliability. This is a continuation of an ongoing effort.

16. Development of Remote Readout Coal Dust Deposition Rate Monitor

Objective: To develop a mineworthy instrument for the measurmement of dust deposition rate in a mine passageway and remotely readout the deposition rate. This is a continuation of an ongoing effort.

17. High Concentration Dust Meter

Objective: To evaluate the high concentration dust meter through field tests. This is a continuation of an ongoing effort.

18. Upgrade Stench Warning System

Objective: Demonstrate the improved stench fire warning system in a large multilevel metal mine. This is a continuation of an ongoing effort.

19. Long Term, In-Mine Testing of Second Generation Spontaneous Combustion Fire Warning System

Objective: To evaluate the in-mine reliability of the second generation spontaneous combustion fire protection system for noncoal mines. This hardware was developed under Bureau of Mines under FMC Corp. contract H0282002. This is a continuation of an ongoing effort.

20. Omnidirectional Fire Extinguisher for Mine Equipment

Objective: To improve and simplify the design of the omnidirectional fire extinguisher and gather long-term ruggedness and reliability data through extensive in-mine testing. This is a continuation of an ongoing effort.

21. Improved Fire Protection For Underground Fueling Areas

Objective: To develop reliable mineworthy fire detection and extinguishment system to protect fuel transfer and storage locations in underground mines. This is a continuation of an ongoing effort.

Methane Control

Program Objectives: To develop, demonstrate, and transfer technology that will prevent the formation of flammable methane-air mixtures in underground mine workings through improved ventilation and procedures for degasifying the coal seam in advance of and during mining. To establish correlations between the geology of the material to be mined and its gas content, and to use these to predict methane emission hazards.

Control During Mining

1. Assess Oil Shale and Salt Mine Ventilation Requirements and Provide Recommendations for Improved Ventilation Systems

Objective: To characterize ventilation requirements for methane control during the mining of salt and oil shale deposits, study the effectiveness of currently existing ventilation systems, recommend ventilation improvements for the mine, and identify the key problem areas that warrant future research. This is a new RFP.

2. Cableless Borehole Survey Tool

Objective: To competitively procure two electronic borehole surveying units for test and evaluation. The electronic surveying instrument aids in maintaining precise control during horizontal drilling, reduces survey time, and permits routine drilling to lengths of 2,000 to 3,000 feet. The instruments shall be tested and evaluated for reliability under a wide variety of drilling conditions. This is a new RFP.

3. Improved Diffuser and Spray Fan System for Ventilation of Coal Mine Working Faces

Objective: To provide a spray fan system with sufficient methane control capability for any gassy work faces; to devise, develop, and test a new auxiliary face ventilation concept, combining the advantages of diffuser fan and water spray ventilation; to evaluate, modify, and upgrade sensor positioning and protection for machine-mounted methane monitors. This is a continuation of an ongoing effort.

4. Improved Check Curtains, Line Curtains, and Extensible Face Ventilation Systems

Objective: Evaluate present check curtains, line curtains, and extensible face ventilation system for cost practicality and air-sealing ability. Investigate ways to improve upon currently used check curtains, line curtains, and extensible face ventilation systems, and design new and improved systems. Select the best check curtains, line curtains, and extensible face ventilation systems and test them at the working sections of coal mines. This is a continuation of an ongoing effort.

Ground Control

Program Objectives: To conceive, develop, demonstrate, and transfer technology that will prevent mine accidents attributable to falls of ground, outbursts, slope failures, and collapse of waste impoundment structures.

Mine Design and Development

1. Field Demonstration of Deep-Penetrating Borehole Geophysical Techniques

Objective: Develop a borehole geophysical technique to remotely sense and locate geologic features that indicate potentially hazardous zones or obstacles to future mine development. Work shall begin to establish practical field implementation of the borehole radar probing method, and then transfer the technology to industry through a series of field demonstrations at coal mine sites. This is a continuation of an ongoing effort.

2. Combined Reflection and Through-Transmission Acoustic Cross-Borehole Logging System for Detection and Delineation of Geologic Hazards

Objective: Develop and test an acoustic system operating between boreholes over distances up to about 330 meters for the purpose of detecting and delineating geological hazards within the borehole spacings. The system shall combine the best features of both reflection and through-transmission acoustic systems. This is a continuation of an ongoing effort.

3. Blasting Parameters That Affect Highwall Stability

Objective: Determine the effect of controllable blasting factors on highwall stability by field testing. Parameters such as blasthole size, loading techniques, delay systems, burden and spacing, bench height, hole inclination, and geology shall be studied. A field manual for use by mine personnel shall be prepared. This is a new RFP.

4. Evaluation and Demonstration of Underhand Stoping to Control Rock Bursts

Objective: Demonstrate an underhand cut-and-fill stoping method that can replace the currently used overhand cut-and-fill method for deep, vein-type mineral deposits, and determine its potential to reduce rock bursts when used in conjunction with rock preconditioning techniques. This is a continuation of an ongoing effort.

5. Wallrock Reactions to Mining a Preconditioned Stope Zone at the Star Mine

Objective: Process microseismic data from the Star Mine using the Bureau of Mines computer facility, locate potential rock bursts, and advise and train mine personnel until stoping is finished in a destressed area 450 feet long between the 7700 and the 7900 levels. This is a new RFP.

Hazard Detection and Monitoring Systems

6. Ultrasonic Forward Scanning for Coal Mine Seam Hazard Detection

Objective: Develop a hand-held, ultrasonic scanner for use at the working face to rapidly and conveniently detect faults and voids ahead of mining. This is a new RFP.

Roof Support Systems

7. Chemical Modification of a Pumpable Resin

Objective: Provide chemical engineering consulting assistance in the field demonstration of the pumpable bolt. This will insure that the quality of the pumpable resin chemistry meets or exceeds minimum safety standards acceptable to MSHA. This is a continuation of an ongoing effort.

8. Commercial Production Feasibility of Inorganic Cartridges

Objective: Identify and evaluate problem areas in the continuous production of water capsules and hydrocal cartridges using commercial equipment, and evaluate the quality of these products through laboratory and field testing. This is a continuation of an ongoing effort.

Safe Support Installation

9. Development of a Roof Competence Tester

Objective: Develop and evaluate a hand-held instrument for accuracy and reliability in detecting cracks, fissures, delaminations, and poorly cemented and otherwise weak rock structure in coal mine roofs. The instrument shall be suitable for use with all thicknesses of coalbeds and different roof compositions. This is a continuation of an ongoing effort.

10. Retreat Mining Support System

Objective: Design, build, and field demonstrate a second generation mobile roof support machine for retreat mining that will operate in 5- to 15-foot coal seams. This is a continuation of an ongoing effort.

11. Design and Develop Standardization Controls

Objective: Extend and apply past research efforts on human engineering technology in a practical, uniform way to new roof bolting machines and demonstrate their contributions in correcting present hazardous, accident-prone situations. The work is detailed design and fabrication. The final control configurations will be adopted in the SAE handbook. This is a continuation of an ongoing effort.

12. Inorganic Grout Slurry Bolters

Objective: Design, build, and mine test a machine that will mix and inject fast-setting inorganic grouts. The final object of the program is commercial acceptance of the bolter. Phase III (laboratory testing of the complete synthesized system) and Phase IV (mine testing and final report) shall be completed. This will include installation of from 70 to 100 bolts to support an intersection. This is a continuation of an ongoing effort.

13. Develop Equipment to Expedite the Safe Installation of Roof Trusses

Objective: Design and demonstrate mechanical installation equipment and practices for solid-rock roof trusses which will speed up the cycle time yet reduce the handling hazards associated with current practices. This is a continuation of an ongoing effort.

14. Fabricate and Test an Articulated Remote, Manual Roof Bolter

Object: Fabricate, laboratory test, and perform an underground demonstration of a prototype, articulating, remote manual roof bolter to evaluate the amount of accident reduction potential and production rate improvement. This is a continuation of an ongoing effort.

15. Extended Field Test of Torque-Thrust Control and Hardened Washers

Objective: Determine the effects of using hardened washers and a Bureau-developed, torque-thrust control bolter on uniformity of bolt tension and roof control. This is a continuation of an ongoing effort.

16. Resin Injection and Resin Doweling for Longwall Face Stabilization

Objective: Define and rank problems of roof and face stabilization in longwalls, evaluate foreign and domestic technology in resin-injection and resin-doweling for application in U.S. mines; select those techniques that indicate the greatest benefits per cost and are not unnecessarily hazardous; develop testing procedures to demonstrate their effectiveness on longwall stabilization problems; perform and document the demonstration and reassess the cost and safety benefits. This is a continuation of an ongoing effort.

17. Remote Drill-Bolting System for Metal-Nonmetal Mining

Objective: Design, build, and mine test a remote drill-bolt system for metal and nonmetal mining that will remove the bolter operator from the bolting operation and place him in a protected area not exposed to unsupported ground or moving equipment. This is a continuation of an ongoing effort.

18. Scaling Tool

Objective: Fabricate a novel scaling tool. A unique tool for mine roof scaling was invented under a contract funded by the Bureau of Mines. The tool will be fabricated and delivered to the Bureau where it will be mounted on a carrier and tested. This is a continuation of an ongoing effort.

Mining and Minerals Processing Waste Stability

19. Aerial Photogrammetric Survey of Surface Coal Waste Disposal Sites

Objective: In conjunction with a companion in-house project, field test aerial photogrammetry techniques to supplement MSHA inspection of coal waste disposal in a selected MSHA district. This is a new RFP.

20. Centrifuge Modeling of Design Criteria of Mine Waste Embankments

Objective: Determine safety criteria for tailings embankments by simulating the field conditions using a centrifuge for modeling. Tests shall be run on a 25-foot-radius centrifuge to investigate seepage and erosion effects, foundation differentials, and other embankment construction problems. This is a continuation of an ongoing effort.

21. Critical Parameters for Tailings Embankments

Objective: Construct probability density functions of soil parameters for tailings embankments of selected mineral commodities in the United States. The contractor shall collect and categorize engineering parameters of tailings embankments for future input to slope probablistic models for slope stability analysis, thus enabling determination of confidence intervals about the factor of safety of tailings embankments. This is a continuation of an ongoing effort.

Industrial Hazards

Program Objectives: To limit the possibility of human error through training and worker-machine interfacing, improve equipment design and controls, detect and prevent failures of electric circuitry and hardware, provide adequate lighting in working areas, insure continuous and reliable communication between all underground and surface personnel while providing continuous surveillance of the mine environment, and improve safety in haulage and materials-handling operations.

Human Factors

1. Benefit-Cost Approach to Coal Mine Training: A Practioner's Viewpoint

Objective: To develop an applied benefit-cost model to be used by training and safety practitioners in assessing the most effective training program for their particular mine site. The focus of the model will be on training investments relative to property damage and loss-time accidents. This is a continuation of an ongoing effort.

2. Development of Materials and Strategies for Normal and Emergency Operation of Equipment

Objective: To develop baseline course materials for major types of surface mining equipment including but not limited to scrapers, dozers, graders, hydraulics, excavators, and drills to reduce the risk to inexperienced equipment operators while assisting mine operators in complying with task training requirements outlined in Part 48, CFR 30. This is a continuation of an ongoing effort.

3. Development of a Standardized Method of Performance Evaluation for Underground Equipment Operators

Objective: To develop a standarized method of evaluating the performance of an operator of various pieces of underground equipment. This is a new RFP.

4. Study to Determine the Feasibility of Utilizing Employee Assistance Programs in the Mining Industry

Objective: To continue with the contract for exploring the feasibility of utilizing employee assistance programs to reduce accidents associated with employee personal difficulties. This is a continuation of an ongoing effort.

5. Cause and Effect of Absenteeism on Accident and Injury Experience of Those Relieving the Absentee

Objective: To determine the effect absenteeism has on the accident and injury experience of those relieving the absentee. This is a new RFP.

6. Development of a Handbook on Mine Rescue Organizations and Procedures

Objective: To develop a handbook that would serve as a guide to mine operators and officials on the proper methods and procedures to follow for conducting a successful mine rescue operation. The handbook would focus on aboveground operations and organization rather than the actual in-mine rescue attempt. This is a new RFP.

7. Low-Cost Methods for Developing and Distributing a Training Package for the Operation of the Oxygen Self-Rescuer

Objective: To develop and validate a low-cost training guide, training techniques that are partially suitable for use in small mines, and informal training sessions. The topic of the training modules will be the use of the new prototype oxygen self-rescue devices. This is a new RFP.

8. Biomechanical and Work Physiology Study in Underground Mining Excluding Low Coal

Objective: To continue the biomechanical study of work in underground noncoal mines with the intent of generating data that will be utilized in the optimal design for the job-work station. This is a continuation of an ongoing effort.

9. In-Depth Awareness of Electrical Hazards for Use in New Miner Training and/or Refresher Training

Objective: Produce a training program suitable for both new miner and refresher training; to enhance the miners' awareness and knowledge of electrical hazards. This is a continuation of an ongoing project.

10. Refinement of the Shuttle Car Training System

Objective: To evaluate and assess the training capabilities of the present shuttle car training system. This a continuation of an ongoing project.

11. Development and Validation of Training Program for Operators of Underground Noncoal Equipment

Objective: To continue with development and validation of training programs that will instruct miners in the proper preshift inspection, operating, and shutdown procedures for various types of major machines and equipment utilized in underground noncoal mines to reduce accidents and injuries. This is a continuation of an ongoing effort.

12. Preparation of Baseline Training Materials for Assisting Compliance-Accident Reduction in the Noncoal Mining Industry

Objective: To assess and evaluate the training materials produced under this contract and allow for contingencies not anticipated for those procurements initiated in FY 81. This is a continuation of an ongoing effort.

13. A Study of Human Engineering and Organizational Development in Underground Metal and Nonmetal Mining

Objective: This work will be a continuation and expansion of a contract initiated in FY 78 with the objectives to identify and define specific human factor problem areas in the underground metal and nonmetal mining industry that are susceptible to research solution or solution through application of state-of-the-art knowledge; and to reduce human error associated with accidents through application of organizational development principles.

Electrical

14. Trial Cable Construction and Usage Improvement

Objective: To improve ability of mine cables to withstand the harsh environment and demanding performance inherent in the mining situation, through improved construction, repair, and handling; and to promote the use or improved methods of cable protection and personnel protection. Continuing contracts.

15. DC Rail Haulage System Electrical Protection

Objective: To find and demonstrate effective means of assuring electrical safety in rail haulage systems. New and continuing contracts.

16. Recommendations for QA Standards in Explosion-Proof Enclosures

Objective: To develop quality assurance (QA) standards for explosion-proof enclosures. These standards would be used by manufacturers and MSHA to ensure that the safety of the enclosures are not compromised by workmanship. Continuing contract.

17. Energized HI Voltage Indicator

Objective: Develop an indicator that could be placed on a high voltage (HV) cable in a power center or switch house that would indicate if the cable is energized. New contract.

18. Recommendation for a Mine Hoist Electrical Inspection Manual

Objective: Develop recommendations for a manual on hoist controls used in U.S. mines. The manual will be used by MSHA inspectors to determine compliance with regulations and for safety inspections of mine hoists. New contract.

19. Environmental Test Criteria Validation

Objective: Conduct an analysis of the validity of the recommended criteria for operational reliability tests of mine instrumentation developed under contract J0100040. New contract.

20. Mine Electrical Power Systems Reliability

Objective: To assess in practical terms the dependability of mine power system components, particularly the protective devices, to determine optimal inspection and maintenance, and suggest areas of improvements. Continuing contract.

21. Examination of Existing Intrinsic Safety Standards for Electrical Equipment Used in Oil Shale Mining

Objective: To examine the unique conditions encountered in oil shale operations expressly to determine the applicability of current permissibility and intrinsic safety standards, and the suitability of the electrical and electronic equipment. Continuing contract.

Equipment

22. A Study to Determine the Need for Lateral Load Requirements on Canopy Regulations

Objective: Determine the limits and desirability of a lateral load resistance capability regulation for underground equipment canopies. This is a new RFP.

23. Radar-Transponder Anticollision Systems for Large Mine Haulage Trucks

Objective: Long-term, in-mine test on the rugged, low-cost, radar-transponder-type anticollision systems

developed in FY 81. This is a continuation of an ongoing effort.

24. Commercialization of the Front-End Loader Stability Indicator

Objective: To optimize the electronic circuitry and packaging of the Bureau's front end loader stability indicator so that the system will be acceptable for incorporation on new front end loaders. This is a continuation of an ongoing project.

25. Development and Assessment of New and Existing Canopy Technology to Lower Coal Seams

Objective: To demonstrate the advantages and desirability of transverse cabs for use in low seams. This is a continuation of an ongoing effort.

26. Development of Limited Coverage Falling Object Protective Structures, for Low Coal (42" or less) Face Equipment

Objective: To successfully demonstrate that limited coverage protective structures can be employed in the low seam situation without adversely affecting operator visibility and comfort. This is a continuation of an ongoing effort.

27. Development of ROPS Performance Criteria for Large Mobile Mining Equipment

Objective: Provide data on large machine ROPS performance criteria by actual rollover tests of two large machines (over 200,000 pounds) to determine if present criteria are adequate. This is a continuation of an ongoing effort.

28. Fabrication and Demonstration of a Continuous Miner Controlled Through a Remotely Positioned Operator Using a Human Engineered Cab

Objective: To develop and then successfully demonstrate the technology for controlling a low coal continuous miner from a remote operator station. Such demonstration will confirm that face equipment can be effectively operated off-board from a human engineered work station located away from the hazard of the face area. This is a continuation of an ongoing effort.

29. Analysis of ROPS in Service for at Least 5 Years

Objective: Examine and evaluate the fatigue-related problems of ROPS due to the vibrations inherent to the machine on which it is mounted and the terrain characteristics of the surface mine. This is a continuation of an ongoing effort.

Illumination

30. Innovative Illumination Hardware Application Engineering and Demonstration

Objective: To refine, application engineering and demonstrate new low glare illumination systems that are presently being developed under other contracts.

31. Illumination of Thin Seam and Specialized Mining Equipment

Objective: To provide assistance to MSHA and the mining industry in the illumination of particularly difficult machines. These machines, such as rope-propelled auger miners and other typically specialized machines that have been exempted from the regulations, will be illuminated and evaluated. New contract.

32. Investigation of Retroreflective Material Applications for Underground Coal Mine Environments

Objective: To investigate the applicability and benefits of the use or retroreflective materials to enhance visibility in underground coal mine environments. New contract.

33. Determination of the Illumination Requirements of Shaft, Tunnels, and Slopes

Objective: Operations study of shafts, tunnels, and slopes to define tasks and work areas for specifying illumination requirements. New contract.

34. Development of Training Materials and Audio Visual Aids on Mine Illumination

Objective: To develop training materials and audio visual aids for instruction of mine illumination technology. New contract.

35. Alternate Ways of Specifying and Regulating Mine Illumination Systems

Objective: To investigate alternate ways of specifying and regulating illuminated underground coal mine environments. New contract.

36. Feasibility Studies and Demonstrations of Proposed Surface Mine Illumination Standards

Objective: To demonstrate the feasibility and evaluate the adequacy of the proposed surface coal mine illumination standards. New contract.

37. Recommendations for Minimal Luminance Requirements for Metal-Nonmetal Mines. Continuing Contract.

Objective: Define and recommend minimal lighting which is required to safely and efficiently perform task, jobs, and unit operations in all underground metal and nonmetal mines. Continuing contract.

Communications-Monitoring

38. Study of Radio Frequency (RF) Hazards at Low and Medium Frequencies to Blasting In Underground Mines

Objective: Determine the hazard posed by low and medium frequency radio systems in underground mines, and to report the results in a comprehensive final report useful to regulatory agencies, communications designers, and the mining industry. Continuing contract.

39. Sixth WVU Conference on Coal Mine Electrotechnology

Objective: To provide a forum for industry, Government, etc., to present the latest developments in coal mine health and safety related electrotechnology. New contract.

40. Guidelines for Environmental Monitoring in Coal Mines

Objective: To develop guidelines for environmental monitoring in coal mines which include cost-benefits, implementation guidelines, and real world case studies. Continuing contract.

41. Multiplex Distribution System for Multichannel Pager Phone Communication

Objective: To design, fabricate, and test a multichannel telephone communication system using the selectable pager phone as a local intercom which will provide maximum communication capability at minimum cost. Continuing contract.

42. Interaction of Mine Radio Systems With Mine Telemetry and Control Systems

Objective: To investigate potential problems concerning the parasitic coupling of electromagnetic energy (mostly medium frequency) into environmental or control elementary lines, and to environmental sensors or control devices.

43. Multiplex Telephone System for Small Mines

Objective: To provide incremental funding for continuation of an existing contract and extending the scope of work of that contract to provide for automatic interrogation of phone flags. Continuing contract.

44. Systems Approach to Mine Fire Safety

Objective: To develop a quantitative evaluation model to be used in rating, in terms of equivalance to CFR Title 30 requirements, fire safety monitoring equipment, and other fire-protection features used in underground coal and metal-nonmetal mines, using a systems approach. Continuing contract.

45. Underground Mine Monitoring and Control Testing Criteria

Objective: To develop a process and test apparatus for evaluating the performance of prospective monitoring systems for use in underground mines. This development will have the capability of performing accelerated evaluations to both software and hardware through the use of a sophisticated computer-based test fixture. Continuing contract.

46. Equipment and Services for Black River Mines

Objective: To provide equipment and engineering servics for timely execution of the "Evaluation of the Black River Mine Telecommunication System" contract. Continuing contract.

47. Evaluation of Black River Mine Telecommunication System

Objective: To independently and objectively evaluate the impact of a passive reflector uhf radio system and a CCTV system on the operation of a room-and-pillar limestone mine.

Haulage and Materials Handling

48. Development of Consistent Low G Hoist Arrestment Devices

Objective: To develop predictable consistent low G hoist arrestment devices which eliminate the high transient forces developed during an arrestment. This is a continuation of an ongoing effort.

49. Personnel Transport Vehicle Demonstration

Objective: Modify an existing vehicle to incorporate the concepts developed under contract H0366003 and then demonstrate-validate the safety improvements affected by this modification. This is a new RFP.

50. Driver Alertness Monitoring Systems for Large Haulage Vehicles

Objective: Develop and demonstrate reasonable prices, reliable driver alertness monitoring systems for large, open pit haulage vehicles. This is a continuation of an ongoing effort.

51. Development of a Fail-Safe, Slack-Overload Rope Protection System

Objective: The purpose is to review existing rope devices to uncover deficiencies that may exist, and correct those deficiencies or develop improved instrumentation for slack-overload protection in keeping with present mining technology. This is a continuation of an ongoing effort.

Postdisaster

Program Objectives: To develop technology that will (1) enable survivors of a mine disaster to escape from the mine or to continue to survive while awaiting rescue by providing protection against toxic and/or oxygen-deficient atmospheres, (2) aid in the location of miners trapped underground, using seismic and electromagnetic means of communication, and (3) facilitate postdisaster rescue and recovery operations through surface monitoring of conditions underground, emergency communications, and mechanized transport and life support equipment for mine reentry and rescue operations.

Survival

1. Lightweight Oxygen Cylinders

Objective: To develop a new U.S. Department of Transportation (DOT) approved lightweight O_2 pressure vessel. To improve mine rescue technology. This is a continuation of an ongoing effort.

2. Compressed Oxygen Self-Rescuer

Objective: Contractor will develop a 1-hour compressed oxygen self-rescuer comparable in size and weight to available O_2 self-rescuers. Thirty units to be accepted by the Bureau of Mines for further tests and demonstrations in part of FY 82. This is a continuation of an ongoing effort.

3. Physiological Responses of Coal Miners to Emergency

Objective: The contractor will quantitatively evaluate the physiological responses (circulatory and respiratory) of both male and female miners while wearing self-contained breathing apparatus (SCBA) for purposes of emergency escape or rescue. This involves measuring the psychomotor and physiological costs to the wearer while breathing against (1) positive pressure, (2) high CO_2 concentrations, and (3) variable resistance. Within the next 3 years, this contract should define safe limits for the parameters listed and publish data to support said limits to support efforts to revise MSHA-National Institute for Occupational Safety and Health (NIOSH) regulations 30 CFR 11. This is a continuation of an ongoing effort.

4. Improved Oxygen Sources for Breathing Apparatus

Objective: Development of solid chemicals that provide more oxygen per unit weight than KO_2 could allow for the design of a lighweight oxygen-supplying breathing device for purposes of escape. Final report will provide information on solid O_2 sources to be used in future oxygen self-rescuer design and development. This is a continuation of an ongoing effort.

5. Evaluation of New 30 CFR 11 Human Subject Test

Objective: Contractor will test current breathing apparatus to determine the ability of these devices to validate newly developed human tests for 30 CFR 11H. Contractor will also test effect of using positive pressure breathing apparatus with new human tests. To revise current MSHA-NIOSH requirements of 30 CFR 11H. This is a continuation of an ongoing effort.

Communications

6. Electromagnetic Rescue System for Deep Mines

Objective: Over the past several years, the Bureau has been experimenting with voice frequency (VF) communication systems for detection and location of workers trapped underground. The present system has been shown to be effective in a substantial number of coal mines and it is anticipated that for mines no deeper than 300 meters, the technology is adequate. However, for deeper mines, which comprise about 10 percent in number and involve 20 percent of the work force, improvements will be necessary. The overall goal of this effort is to

investigate possible alternatives, select the most promising of these options, and build and demonstrate implementing hardware. This is a continuation of an ongoing effort.

7. Adaptive Noise Cancellation Techniques

Objective: To study adaptive noise cancellation techniques using multiple three-axis loop antenna and develop algorithms to implement these techniques. This is a new RFP.

8. Reliability Study of Trapped Miner EM Transmitters

Objective: To conduct a test program that will determine the durability and reliability of the Bureau-developed trapped miner location system, and to submit a comprehensive final report on all work, conclusions, and recommendations. This is a continuation of an ongoing effort.

9. Real Time Seismic Auto Detection

Objective: During the past year the Bureau has funded work to develop algorithms to enable MSHA's trapped miner seismic location system to automatically detect and locate trapped miners. However, these algorithms will not be capable of implementing real time operation with the present system. The objective of this proposed contract is to provide real time operation of the developed algorithms. This is a new RFP.

Rescue and Mine Recovery

10. Low Profile, Lightweight Rescue Breathing Apparatus

Objective: Contractor will build 10 preproduction units of a 2-hour, low-profile, compressed oxygen rescue breathing apparatus (RBA) which will be suitable for use in low coal and at longwall faces. The RBA's will be developed and available for MSHA evaluation in early FY 84. This is a continuation of an ongoing effort.

11. Study and Design of an Integrated System of Mine Rescue Team Personal Protective Equipment and Clothing

Objective: To critically review personal protective equipment used by mine rescue team personnel and miners from the viewpoint of how adequately each piece of equipment affords the needed protection and is integrated with other equipment worn by a member of the team. To perform research and development of personal protective equipment for mine rescue. This is a continuation of an ongoing effort.

12. Comparison of U.S. and Foreign Rescue Techniques and Equipment Used to Locate and Communicate With Trapped Miners

Objective: The contractor will determine the techniques and equipment used in other countries to locate and rescue trapped miners. A comprehensive report will be written on the subject. This is a new RFP.

Explosives

Program Objectives: To assess the problems associated with the safe and effective use of explosives in all types of mining activity including fixed explosives, blasting agents, blasting devices, and blasting accessories. To conduct fundamental studies of explosive behavior and apply the results in the development of new technology. To develop new and improved test procedures as new mining methods are introduced and new types of explosives are formulated.

Blasting Practices

1. Review of European Blasting Practices Used in Underground Mines and Permissibility Testing Procedures

Objective: To review underground coal, metal, and nonmetal blasting practices and permissibility testing and identify those techniques and procedures which relate to U.S. mining practices. This is a new procurement effort.

Systems Engineering

Program Objectives: To operate and maintain underground research and test facilities for use in testing and demonstrating new procedures and equipment before they are field tested in commercial mines.

Systems Analysis

1. Development of a Pilot Program for Underground Mine Rescue and Emergency Utilizing Cooperative Resources

Objective: To investigate ways and means by which State facilities can be utilized in responding to mine disasters. This is a continuation of an ongoing effort.

2. Analysis of Economic Impact of Fatal-Nonfatal Accidents in Surface Coal and Metal-Nonmetal Mines

Objective: To develop surface coal and metal-nonmetal mine cost data bases for each year where coal accident and injury files are available from MSHA and develop an interactive information retrieval system. This is a continuation of an ongoing effort.

Test Facilities

3. Construction and Installation of Wire Hoist Horizontal Axial Fatigue Tensile Testing Machine

Objective: To build a wire rope testing machine and test hoist ropes of commonly used sizes and construction to subsequently obtain reliable data that can be used to improve retirement criteria standards, aid users in proper wire rope selection, improve MSHA inspection procedures, and improve MSHA wire rope regulations. This is a continuation of an ongoing effort.

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